

legs and 15 humeri were located. While photographing a nest, 3 crows were brought for the nestlings<sup>15m</sup>.

In Michigan on the morning of 18 May 1945, an adult Red-tailed Hawk, *Buteo jamaicensis*, had a dead crow in its talons. Perched in a tree, the hawk flew off without the body when it was approached. The crow was warm with talon marks from the hawk about its neck and head<sup>b58</sup>.

In Los Angeles County **California**, a crow destroyed a set of eggs of a Red-tailed Hawk. "The remains of shells and contents, and a telltale black feather, told the story. This was in a locality where crows were nesting, and were very plentiful"<sup>e13</sup>. On the Canadian prairies near Rochester **Alberta**, at least 8 mammal types and 15 bird species were brought to nourish the young in 10 nests of Red-tailed Hawks. Only 1 (0.5%) crow was counted<sup>17m</sup>. Breeding pairs of Osprey with nestlings were much more aggressive toward crows than when eggs were being incubated. Osprey in **Nova Scotia** chased, but did not kill any crows<sup>j14</sup>. A Sharp-shinned Hawk, *Accipiter striatus* (length 25–36 cm) killed a crow on Mackinac Island **Michigan**<sup>w78</sup>.

In Green County **Wisconsin**, beginning in the

winter of 1953, the trails of Red-tailed Hawks and Great Horned Owls were followed for 3 years. Five other raptors bred in the area. The major fare for both species was Ring-necked Pheasant and Cottontail Rabbit. Food remains at 87 Red-tailed Hawks' nests included 9 crows. Remains of prey in 41 nests of Great Horned Owls included 5 crows<sup>o21</sup>. In **Maryland**, crows destroyed the nest of one Great Horned Owl, because, according to the observer, the crows were out marauding<sup>33b</sup>. In

Trelease Woods **Illinois**, the disappearance of nestling crows began with the appearance of Great Horned Owls<sup>k31</sup>.

In **Virginia** in late November, a crow felt the power of a Great Horned Owl. Perched in a tree, the owl was being mobbed by the usual courage of crows. One crow came slightly too close. In an instant the owl's left foot shot out. The crow did not struggle. Less than a minute later, the owl with its kill headed for the safety of the woods with an angry parade of blackshirts in pursuit<sup>d35</sup>.

In case you may think the crow / owl relationship is all one-sided, one account revealed how An adult Great Horned Owl with young in the nest; April in **Winnipeg**

nest-tree. A bruise on their wing tips matched the crow's method of removal<sup>32c</sup>. In my opinion, the human was the main reason for the death of the owlets.

At the Essex crow roost in southern **Ontario**, I often enjoyed a morning's walk after the majority of crows had left for the day. Dead crows, some partially eaten, dotted the floor of the woodlot. On nearby snowy fields, headless crows, probably the result of night moves by a Great Horned Owl, were easily approached for inspection. In Winni-peg **Manitoba**, 1 or 2 large crow feathers usually rested on the ground below each of two Great Horned Owls' nests in deciduous trees.

Snowy Owls in **New England** did not have crows in their stomachs. At Detroit **Michigan**, however, Snowy Owls killed and ate full-grown crows. The crows, in turn, mobbed the owls<sup>g74</sup>. A collection of 68 pellets came from Barred Owls, *Strix varia*, near Urbana **Illinois**. The owls fed mostly on mammals, much less on birds, but did take one crow (3%)<sup>c23</sup>.

crows, assisted by human interference, were able to kill a Great Horned Owl's nestlings. One human flushed an owl from its nest and when the owl returned, a dozen crows were her entourage. Again she was scared away, but a few of the crows stayed, and the boldest one easily used its bill to flip an owlet from the nest. This intact nest-ling was returned to the nest by the human. Later, both owlets were discovered dead, but not eaten, at the base of the

snowy field where the crows roosted at **Essex**

On 14 May in the southeast corner of **Michigan** (Monroe County) a Peregrine Falcon (length 45 cm) flew from a clump of cottonwoods with a crow in its talons. Another crow was in wild

A night's work for a Great-horned Owl. Found on a

**Population Characteristics**

To watch a raptor take a crow is not an everyday experience. Such a life-and-death incident took place on 28 June 1950 along the north shore of the Gulf of St. Lawrence in **Quebec**. A Red-tailed Hawk removed a large crow nestling as the parents voiced their despair in sounds that “were almost human in their tone and inflection.” The pair of crows forced the hawk to drop their dead nestling on the beach. Later, a Black Bear, *Ursus americanus*, ate the nestling<sup>t26</sup>.

Red-tailed Hawks occasionally prey on American Crows. Photograph © Maggie Lesoing, from simply-san-juan.com, with permission

pursuit. It was assumed the falcon had taken a nestling from the crow's nest<sup>70s</sup>.

In Everglades National Park, southeastern **Florida**, four aspects of the natural history of the Short-tailed Hawk, *Buteo brachyurus* (39 cm long) were recorded. A sample of the available avian prey in the area was made and 20 species were listed. The American Crow's availability was well down the list and none were counted at nest remains or in regurgitated pellets. The top three birds from nest remains were Eastern Meadow-larks, Red-winged Blackbirds and Yellow-billed Cuckoos, *Coccyzus americanus*, the first two were common birds in the area<sup>o07</sup>.

Our smallest hawk, the American Kestrel, used some of its energy on 19 June harassing a pair of crows in Guelph **Ontario**. As I neared the crow's nest-tree, a few minutes after sunrise, I heard the excited calling of the kestrel. It made four dives from 20 m above a crow perched on the corner of a 4-story building. The hawk, with legs extended, caused the crow to duck its head with each pass. Growing weary of the hawk's

On 8 August 2005, six observers watched a Bald Eagle, *Haliaeetus leucocephalus*, kill a lone American Crow that was chasing / mobbing a Red-tailed Hawk, *Buteo jamaicensis*. The eagle snatched the crow out of the air, then carried the dead bird to a bank. A minute later, it flew away without the crow. The crow and eagle were hidden from view making it impossible to know if the eagle ate any of the crow<sup>o27</sup>.

In northern **California**, from 1983–'92, a study of Bald Eagles identified 2,351 prey items on 56 of their nesting territories. Diet composition was – fish 74%, birds 22%, and mammals 4%. The American Coot (5%) and Mallard (2%) were the top avian items. The remains of one American Crow was identified<sup>j01</sup>.

A Bald Eagle took a crow in flight at Stevens Point **Wisconsin**<sup>l67</sup>. It was on 17 October at 07:30 on a cloudy day. Struck in the air by the eagle, the injured crow hit the water and the eagle finally retrieved it on its third try. It flew to a stump in the lake and ate the crow. "Two other crows silently flew over the scene."

In Seattle **Washington**, there were two apparent predation events by Bald Eagles on two large nestlings of Northwestern Crows. The kills were not observed. The eagle carried a lifeless

Then, when the pair of crows flew from the tree at my approach, the kestrel chased each in turn. Finally, the hawk slipped away, leaving the crows in peace.

## Eagles

At times an interesting play of birds can develop around a kill. In a snowy field in **Utah**, a Ring-necked Pheasant, *Phasianus colchicus*, died on 27 January 1973 from the claws of an adult Golden Eagle. Very soon 3 magpies and 12 crows arrived at the kill. Whenever the crows reacted in a startled manner, the eagle paused in her meal to survey the surroundings. The magpies were more daring and active around the feeding eagle. The crows remained quietly nearby or flew after magpies that managed to steal a scrap of pheasant. Within 25 minutes the eagle left its kill. An hour later the corvids had eaten the remaining meat and they too left<sup>p71</sup>.

nestling on 21 May, and then a fledgling on 9

(1) Yellow-billed Magpie 6% June, and each were followed by a few mobbing

(2) Western Meadowlark 1.6% crows. Other reports of Bald Eagles feeding on

(3) Great Horned Owl 1.4% crows were listed in the paper<sup>r92</sup>.

(4) Valley Quail 0.8% Also in western **Washington**, prey remains

(5) American Crow 0.6%<sup>c36</sup>. were collected near nests on 119 territories of Bald Eagles in three regions of the state. Ob-

In a study of crows at Cape Cod **Massachu-**servations of adults bringing food at some nests  
**setts** in the 1980s, Raccoons destroyed nestlings were made and compared to food collected near  
in five nests of crows; Great Horned Owls took nests. Collected food amounted to 1,198 items of  
out nestlings from three nests; three fledglings 83 prey species. In groups –

were run over by humans in powerful cars, and one nestling or fledgling died from each of – in- (1) birds 53%  
jury, infanticide, hunting, adverse weather. Two (2) fish 34% (including discarded fish heads)  
fledgling crows starved. Predation in the wooded (3) mammals 9%  
barrier beach habitat was higher than predation (4) invertebrates 4%

on crows nesting in the urban environment, prob- ably due to an abundance of raccoons<sup>c56</sup>. The top three  
birds were –

**Mobbing** Western Grebe *Aechmophorus occidentalis* (n 55) Common Murre *Uria aalge* (n 49)

In Winnipeg **Manitoba**, throughout the four sea- Glaucous-winged Gull *Larus glaucescens* (n 37)

sons, crows respond quickly by diving at a Com- mon Raven cutting the invisible boundary of their The  
American and Northwestern Crows, and  
territory. Crows chase Red-tailed Hawks. The Common Ravens were each represented 3 times  
blackshirts also mob Turkey Vultures, *Cathartes* at the eagles' nests<sup>k90</sup>.

*aura*, Black Vultures, *Coragyps atratus*, and In central **California**, there were about 20

Crested Caracara, *Caracara cheriway*<sup>j41</sup>. nests of Golden Eagles, *Aquila chrysaetos*. Prey

Richard Staniforth in **Winnipeg** watched a remains at the nests were counted. Although not a raven land on a crow's nest in a spruce tree and complete list, the four components were –

tear apart the nest cup for about five minutes. The breeding pair of crows began calling and **(1)** mammals 15 species

diving at the intruder, and within a minute about **(2)** birds 16 species

50 crows joined the mobbing. After the raven left, **(3)** reptiles 3 snake species

the breeding crows repaired the nest and contin- **(4)** fish 2 species

ued their nesting activities (pers. comm. 20 April 2011). From the list, the crow was tied for 5th –

A three-part series of artificial situations was

The American Crow **244** tom4crows.com

Breeding American Crow looking into its nest on 3 June 2011. The tan ends of fresh twigs are visible

### Population Characteristics

innate or learned is in- volved”<sup>b32</sup>. From my hunting experience in the winter, flying crows can be drawn in by shaking a dead crow or a soft black hat. Apparently, the awkwardly moving blackness excites them. When- ever Lorenz held something black and fluttering, jackdaws in his company set upon him with their rattling attack. Naked nestlings of Jackdaws in his hand caused no parental anxiety. However, once the nestlings acquired their dark apparel, hold- ing them brought forth a vigorous attack from the adults  
171

On 9 May 1985, at the Monomoy National Wildlife Refuge in Chatham **Massachusetts**, a traveling juvenile Bald Eagle, flew through a flock of about 1,000 Herring and Great Black-backed Gulls, *Larus marinus*. The eagle was mobbed by a Peregrine Falcon, 5 American Crows, a female Northern Harrier, 2 Short-eared Owls, along with at least 50 gulls and 75 Red-winged Blackbirds. Each species maintained a specific distance from the eagle as it flew and after it landed. All the spe- cies ignored their own differences and combined forces against the larger predator<sup>61h</sup>.

established at the University of Washington in **Seattle**. Breeding crows were confronted with –

**(1)** a life-size plastic Great Horned Owl **(2)** an owl with a plastic crow lying in front of it **(3)** an owl with 28 cm piece of black, velvety cloth in front of it

The last two arrangements produced louder and more intense calling by the mobbing crows, but there was no significance difference in the response. It was suggested a simple “releasing mechanism, whether

What are the stimuli that cause birds to mob owls? To find out, a model of an owl, then taped vocalizations, and then the model plus the tape were employed. The model of an Eastern Screech Owl with a tape of its calls attracted the most birds, with the most intensely, and for a longer period of time. It was suggested that mobbing behavior against owls might cause the owls to reduce calling and flying during daylight hours (reducing their hunting success). Owls spend the day concealed by roosting

in a tree<sup>c58</sup>.

Crows' reactions to birds of prey varied according to the species. American Crows generally

ignored Red-shouldered Hawks except when they flew close to their nest. Red-tailed Hawks were routinely attacked throughout the year by crows

Eight crows mobbing a Bald Eagle, 17 June 2012, Seattle **Washington**. Photograph © by Ingrid Taylar, with permission; visit [ingridtaylor.com](http://ingridtaylor.com) for her great avian photographs

The American Crow **245** Tom Reaume 2013

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Two juvenile American Crows watch an approaching parent and occasionally by Red-shouldered Hawks. Crows and Red-shouldered Hawks jointly mobbed Barred Owls and Great Horned Owls<sup>k41</sup>. On one occasion 136 crows were mobbing an owl. Calling by some crows attracted neighboring crows, which quickly formed a courage<sup>k63</sup>.

In Highlands County **Florida**, several crows and a Red-shouldered Hawk called excitedly while perched in a small grove and looking at the ground. With further investigation, Kilham saw three piles of dark feathers from a Wild Turkey, *Meleagris gallopavo*, on the ground. The feathers were a sufficient stimulus for the crows and hawk to react vocally<sup>k45</sup>. Carolee Caffrey watched mobbing crows knock a Barn Owl, *Tyto alba*, out the air to the ground<sup>v18</sup>.



At Encino **California**, American Crows feeding in the afternoon responded to calls of 4 species of birds, two of which were common local predators. From 22 playback trials, the 4–17 crows per trial all took flight away from the source when calls of a Red-shouldered Hawk, *Buteo lineatus*, a daytime predator, were broadcast. When calls from a Great Horned Owl, *Bubo virginianus*, a nighttime predator were broadcast, 86% of the crows that took flight, flew toward the calling. When an owl was located during the day, crows often mobbed it. Calls from the other two bird species did not cause the crows to abandon their

The American Crow **246** tom4crows.com

## Population Characteristics

feeding<sup>h54</sup>.

At the Hamilton **Ontario** roost, a hawk sometimes made an early evening pass in fading daylight over a few thousand crows assembled on the treed Niagara Escarpment cliff prior to roosting. Clamoring into the air with hawk-induced zeal, a group of the crows swarmed above the brown-winged predator, tracing its flight until it left.

Mobbing behavior is exciting to watch. On 15 November, in St. Catharines **Ontario**, about 100 crows formed a dark cloud above the easy, circular movements of a Red-tailed Hawk set against full white clouds. Through field glasses, I saw several crows in turn, at 300 m elevation, peel off, as in an aerial dogfight, dive at the buteo, shoot past it, then rise to rejoin the flock. In unison, the two opposing forces moved with the clouds beyond my view. Although outnumbered, the hawk was not in any danger, and continued to soar while scanning the landscape.

In south-central **Pennsylvania** two American Kestrels and 3 American Crows rose higher and higher for about 5 minutes, as they dove at each other. This was at 10:00 AM on 15 June 1955. When any bird gained an altitudinal advantage, it would dive at the enemy below. Several times three crows would be diving as one but at different depths. When the conflict ended, the birds could hardly be seen with the naked eye. Finally, the crows withdrew<sup>06s</sup>.

A study was initiated in **Arizona** on the breeding biology of Purple Martins that nested in abandoned Gila Woodpecker and Northern Flicker cavities in Saguaro, *Cereus giganteus*, in Saguaro National Monument and Tucson Mountain Park. The mobbing reactions of the nesting martins to a plastic crow placed near their nests' cavities, when their nestlings were about 10 days old in early August, was noted. Although the nearest nesting neighbor distance was 100–400 meters, groups of 6–10 martins mobbed the plastic crow, diving at it in 50% of the trials<sup>79s</sup>.

Scientists, in their curious ways, try many experiments. One case involved two nestling crows, one and two weeks-of-age. They were hand-reared beneath a stuffed Barred Owl and a Cooper's Hawk. The researcher was trying to determine if the crow's fear of owls and hawks was acquired, or an innate response to their enemy. Later, when a live owl was substituted, Ramsay concluded the two species had learned to live together in a pen. From the start there was

quiet, dark water. Above, Red-winged Blackbirds come bouncing in and settle on the rumpled fruiting heads of cat-tails to begin establishing their territories. At the same time, crows are building their nests. In the resulting movements, territories are violated. Whenever a crow flew over the worn spring landscape, a fist of 1–5 red-wings and Common Grackles chased and dove at it. This

Large feathers and regurgitated pellets beneath the nest of a Great Horned Owl, late April

no definite aggression by either species except for some bill snapping by the owl when the crows both called out and approached too closely. Placement allowed the birds to become socialized<sup>r06</sup>. Lorenz

thought most passerines do not have an innate species recognition. "When one rears them in isolation from a very early age they will not recognize conspecifics as such"<sup>172</sup>.

Birds were watched on islands off the north-eastern tip of Long Island **New York** up to Rhode Island.

Four American Crows took up residency on Great Gull Island before the terns returned in the spring to nest. Whenever the crows tried to leave the island the terns attacked them. The terns pulled out feathers and shit on the black-shirts. A part of the upper bill on one crow was broken off. The fright of the crows made them so tame one was actually caught. The crows were put out of their misery by

the observers<sup>d79</sup>. The animation generated between larger avian predators and crows is wonderful to watch, but so is the harassment by small birds towards crows. It is mid-March, and I am waiting for the remaining ice on the marsh to melt so I can look at precise reflections of last year's

cat-tails in the

kept the crow moving quickly in a line through the birds' territories. Although no mending was necessary, these assaults interrupted the crow. Under attack when flying, the crow lifted and turned its head to face the attacking bird approaching from the rear.

An open bill faced and repelled the attacker. In doing so the crow almost stalled. Other tricks included a quick roll to lose altitude. With these maneuvers, a precious few seconds were gained in flight. Not until Silky Milkweed, *Asclepias syriaca*, were finished blooming in August was the crow again

able to appreciate lazy flights over the luscious, multi-colored, soft landscape. The Eastern Kingbird etches itself in the crow's memory through the sensation of pain. It can and does land on the backs of flying crows to peck them. When 3 kingbirds attacked a lone crow, it cried out and sought shelter in a tree to let *Tyrannus tyrannus* cool down and disperse. The Purple Martin, Western Kingbird, Yellow-headed Blackbird and Scissor-tailed Flycatcher also reacted aggressively towards the

crow in their nesting territory<sup>g34</sup>. Crows may also be

chased by Blue Jays<sup>1b7</sup>, Pinyon Jays<sup>m46</sup>,

Northern Mockingbirds<sup>v18</sup>, and American Robins<sup>p97</sup>.

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Did nest defense by parents increase as the nesting season progressed and older nestlings occupied a nest?

In south-eastern **British Columbia**, a taxidermic mount of an American Crow was placed near active nests of Eastern Kingbirds in the Creston Wildlife Management Area. As it turned out, “Eastern Kingbirds defended their eggs as vigorously as they defended their young.” The kingbirds were less defensive when an empty nest was at stake. As well, from repeated exposure, up to 3 times to a stuffed crow, the kingbirds reduced their level of aggression since they may have realized the fake crow was not a real danger to the contents of their nests<sup>s81</sup>.

Starlings and nuthatches are cavity nesters, building their homes in street-poles, decayed eaves, or a hole in a tree. Hole nesting generally affords more protection from crows. This may explain why they do not chase crows.

## Mammals

Adult American Crows have a few mammalian predators. But when urban fledglings fall to the ground, domestic cats were waiting. In cities, crows always chase squirrels from the area of their nest-tree. There was a report of a Gray Squirrel, *Sciurus carolinensis*, being mobbed by a dozen jays at Athens **Georgia**. In spite of this, it captured and ate a Blue Jay fledgling attempting to fly<sup>43m</sup>.

When a large flock of roosting crows sleep on

The American Crow **248** tom4crows.com

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the ground, a mink or coyote could prey on them. Raccoons are probably the most abundant wild mammal capable of visiting a nest to consume eggs or nestling crows. Laurel Van Camp banded 100 crow nestlings in the late 1940s in Ottawa County **Ohio**<sup>g34</sup>. A few years later, he could only locate about 1/4 as many nestlings, a reduction he thought was due mainly to Raccoons. Mil- lar (pers. comm. 1984) has noted a significant decrease in nesting success for the crow and magpie around Saskatoon **Saskatchewan**, which he believed was partially due to an increase in Raccoons. This was not surprising because I have watched a Raccoon easily climb straight up the trunk of a 25 m tall White Pine.

In the Midwest, foxes occasionally dine on crow<sup>e52</sup>. Usually it's the lunch special on the first Tuesday in

## May Injuries

he extremities of crows receive the hard knocks of life. Wings and feet take the worst beating. Once you look at enough crows, you start to notice more than black. In the distance, the aesthetics of a feeding crow are not quite right. Closer, I watch as the feather tips of one wing continuously slip off the uppertail coverts. The wing is repeatedly flicked back into place as the bird walks on a lawn. This is the most familiar and obvious small injury. Typically, it

were completely vulnerable in the open, especially with snow on the ground to outline their position. Unable to fly, they would eventually be a meal for a raptor, mammal or bacteria. After a full night's sleep, I attempted to capture one of these birds. As I left the road and walked towards it, the wounded crow headed back into the woods. Chasing a crow over a Three-flowered Avens in Tall Grass Prairie – early June

involves only one wing of a bird. Each year a few crows in the city have this mild injury. It helps to identify them as they move about their territory. The Essex County roost in **Ontario** was the one I was most familiar with in the 1980s. Its 100,000 or so members gathered each winter in a small deciduous woodlot on the outskirts of the town of Essex. Over 150 days of roosting, I estimated 200–400 crows died or were badly injured at the roost from various causes. At a roost of 25,000 crows on Boot Island **Nova Scotia**, it was estimated less than 100 birds were lost over its seasonal existence each winter<sup>25m</sup>.

Major wing injuries get right to the point of what a bird is about. A grounded bird may soon equal a lifeless bird. Slowly driving past the roost used by tens of thousands of crows in Essex County, one or two birds were usually walking in the bare farmland surrounding the trees. They didn't feed much, and

Crow perched at the very top

It is a mystery why more wing injuries do not happen. If you are lucky enough to stand in a roost

**Population Characteristics**

woodlot's floor was a breath-taking experience. Thirty meters later, the crow stopped and flopped onto its side as I reached for it. Quite still, it stared at me without making a sound. I gently picked it up. The crow did not peck my hand, struggle, or call. The tips of the tail feathers suggest it was an older bird. A few measurements and photographs were made before I released it. I always experience a child-like wonder when I hold a warm bird in my hands, especially when it is a crow. Its closeness causes sensations completely beyond my

daily encounters with this wondrous songbird.

Ventral (underside) of left injured wing of a wild American Crow. The line points to the damaged skin and exposed metacarpal bones. The skin graft from a pig was placed over this area h88, © Journal of Avian Medicine and Surgery, with permission

Some injuries can be fixed. A porcine (pig) small intestine submucosa (SIS) tissue in a xenogenic (unrelated species) graft was used to repair 4 injured birds, including the damaged wing of an American Crow. The crow may have been struck by a vehicle which caused the traumatic wing injury. On the underside of the left wing a 5 by 2 cm skin tear exposed the metacarpal bones<sup>h88</sup>. A 3% isoflurane

(a halogenated ether used for inhalational anesthesia by veterinarians) was used to reduce the level of pain.

“The crow was then intubated with a 3-mm endotracheal tube and ventilated manually every 5 seconds during surgery. The porcine SIS was tucked under the epidermal edges of the entire wound and sutured in place, rough side toward the wound. The SIS was trimmed as needed to overlap approximately 1 mm un-

Underside of repaired left wing of a wild American Crow. The grafted skin healed and the crow was released back into its world h88, © Journal of Avian Medicine and Surgery, with permission

### Population Characteristics

der the epidermal edges. The graft was covered with a triple antibiotic ointment and a nonadherent dressing. A figure-of-eight bandage was applied to immobilize the wing and maintain the dressing in place.”

The skin-graft healed properly and by the end of the third week was dark and adhered to the underlying tissue. The bandage was removed and the crow discharged to a wildlife rehabilitator. The crow was initially kept in a small cage to restrict wing movement. At week 7, the new epithelium appeared normal. The crow was put in a large aviary where flight was possible. Three weeks later the flying crow was released<sup>h88</sup>.

Injured crows in the urban environment may be cared for by other crows. In March I heard begging calls in **Guelph**. It was too early to be a juvenile crow, or an incubating female calling. At the source I found a crow without its primary feathers perched on a branch. Three crows, perhaps its family members, were attending it. In June probably the same flightless bird was feeding with another crow on lawn in the general area. It walked away at my approach. This bird had survived at least three months. In time, the molt may restore its avian powers.

Near Clarence **New York**, a dead crow hung in a maple tree about 4 m up. Examination Probably an older crow in **Essex** that has endured a few events in its lifetime. The right foot is without some toes and the left wing hangs to the side. It remains a crow. Examination of the limb revealed a branch had broken off leaving a sharp point. Flying over it, the adult crow punctured its wing membrane and there the bird hung until dead<sup>s57</sup>. At the **Essex** roost one morning, I happened upon a live crow hanging by its wing tip. Later that afternoon, tracks and a discarded pole told me snowmobilers had removed the unfortunate bird. Earlier in the season, another crow, alive but grounded at

the roost, had the outer right primary feathers barely attached by tendons.



leg and toe injuries do not enhance the lifestyle of any crow. A Northwestern Crow walking on the docks of Bella Coola **British Columbia**, had the toes of one foot completely curled into a “fist.” A crow in **Guelph** with a similar “fist” limped along, but it was able to land in a tree top. At the **Essex** roost, one crow in 100,000 managed to lodge its foot between two small branches. It struggled as I took its picture. The next day it was gone.

Ernest Good saw a crow with its left leg protruding out the side and not used for walking<sup>g34</sup>. I occasionally watched a crow with one tarsus missing as it hopped around on its whole leg and fed on a lawn behind the Veterinary

## Population Characteristics

College in Guelph **Ontario**. To survive it made several adjustments. It could not perch on a thin or vertical branch. It was confined to the lower, thicker horizontal limbs in a tree. After landing on a limb or fence post, the crow lowered its body and center of gravity to provide stability. When feeding with family members on a lawn, one or two hops at a time gave it the necessary mobility. A short hop backwards or to the side helped to maintain its balance. Its wings were occasionally extended when the body wavered. It could not cover the same walking distance of a standard model, yet I saw it capture three large earthworms in a few minutes. For a normal crow, an earthworm was secured with its bill, stepped on, and torn into several pieces for ease of swallowing. For this distinctive, one-legged crow, the luxury of a slow meal was impossible. Each earthworm it caught

At the **Essex** roost in the morning, the left foot of a crow is caught between two erect small branches. Flapping the wings (right) didn't set it free this time. If the toes are torn off, the crow may escape

was swallowed whole. A combination of looking, hopping and gulping summed up this crow's feeding method. Confronted with a wind-row of leaves against a fence, the crow scattered the leaves with several sweeps of its bill. Then a thorough visual search was conducted without one hop taken. This crow appeared to take off and land without much difficulty. It preened itself, but scratching its head with its toes was never

observed. In Ithaca **New York**, while studying vocalizations of crows, it was noted that several

birds were missing feet<sup>107</sup>. In a woods near **Ottawa**, a crow was shot on 6 May that had about an inch (2–3 cm) of its healed tarsus visible. This male bird was otherwise healthy and its gizzard was filled mostly with earthworms<sup>20</sup>.

Pondering avian mishaps leads to the predictable question—is the left or right side more prone to injuries? Although a sample of 100 events is needed, from a tiny sample at the **Essex** roost, 4 of 5 living crows had damaged left wings. Are

A crow at the **Essex Ontario** roost had its right wing caught in a branch in the morning



### Population Characteristics

crows right or left-winged to explain this propensity? Researchers have proposed molecules have a right or left handedness, so why not crows?

Deformed bills are usually rare. The frequency was estimated at less than 0.5 %<sup>37c</sup>. I have not seen any. In his **Ohio** study, E Good found two crows with badly deformed bills. Surprisingly, the birds were well fed and in "good humor." They were also older birds when collected<sup>g34</sup>. A Northwestern Crow, a mated male, repeatedly fed an unmated adult female that had a slightly malformed beak and one blind eye. This male also cared for its own nestlings<sup>v09</sup>.

Recent field work in 2007 and 2008 identified

beak deformities in 17% of 186 Northwestern Crows at 6 capture sites in **Alaska**. This is the highest rate of deformities recorded in a population of wild birds. On the Kenai Peninsula of Alaska, the rate of a subset was 36%. Near Vancouver and Puget Sound **Washington**, 64 crows also had deformed bills. The bills had elongated and often crossed beaks. Black-capped Chickadees were also found with beak deformities in Alaska. Bill deformities may be due to poor development, genetics, injury, disease, or chemicals<sup>v05, h67</sup>.

Chemicals that injure and kill birds still pollute our environment. Some 998 chemicals were tested on 68 species of birds to determine the acute oral toxicity, repellency, and hazard potential. The American Crow was tested with Bay 79845, Captan,

and Lindane. For Bay 79845, the LD50 mg / kg was less than 10; for Captan and Lindane it was greater than 100 mg / kg<sup>s36</sup>.

Tarsus was the name I gave to a malnour- ished nestling with all the toes on her right foot missing. In 2011, she fledged from a nest the same time as her 3 larger, normal nest mates. This young crow, unable to fly, was killed 10 days later on the ground. Her wing chord was 16 cm long. Tarsus came from one of the most success- ful nesting families I studied in **Winnipeg**. For several years the pair nested in the same Colo- rado Spruce and reused the same nest. The lack of toes on one foot may have been due to a birth defect, or an early injury in the nest.

KW Prescott was banding birds in **New Jersey**. On 28 April 1968, he banded an adult female Red-winged Blackbird with no toes on its right foot. The bird was healthy and perched with American Crow with a damaged left foot that forced it to hop. The stiff foot stuck out even in flight, but the bird could land in the middle of a deciduous tree. The tips of the tail feathers receive extra wear due to the crow's altered stride and stance – 11 October 2011, **Winnipeg** ease on a branch when released. Its weight and

wing chord length were normal. A year later on 2 May 1969, he trapped an adult Blue Jay with its right foot missing and cleanly healed. Its weight and wing chord length were also normal. How and when these two songbirds lost some of their parts was not known p98.

O bright pods Of the pepper  
plant, you do not Need to bow  
and beg pardon. I know you  
cannot hold back The passing  
day.

– Li Ch'ing Chao<sup>r47</sup>

## Wind turbines

A new addition to the aerial landscape are the 3-bladed turbines or HAWT (horizontal-axis wind turbines). The blades are usually light gray

### Population Characteristics

to blend with the clouds and range in length from 20 to 40 metres. The tubular steel towers are from 60 to 90 metres tall. The blades rotate at 10–22 revolutions per minute. At 22 rotations per minute, the tip speed exceeds 90 metres per second, or 320 kph (wiki).

Standing tall and staring straight ahead into the wind, they reminded me of the mechanical creatures in the 2005 movie, *War of the Worlds*, with Dakota Fanning. The HAWTs are a danger to local birds and to those that migrate. Results of studies are beginning to emerge. Although their avian slaughter doesn't appear great, some birds are probably more susceptible than others. And more turbines are being erected in the windiest areas each day.

PNAWPPM—4 2001 was the fourth in a series of conferences on the effects of wind-turbines on birds<sup>p74</sup>. The overall rate was 0.23 fatalities / turbine / year on study plots with 685 turbines at the Altamont Pass Wind Resource Area (APWRA) in northern **California**. On the study plots, turbines were used by raptors most often for perching (36%). Other sites for perching were power poles (31%) and anemometer towers (28%). During a 5-year study, over 50 avian species were killed at the AWRA. The top three were –

**(1)** Red-tailed Hawk 18% **(2)** Rock Dove 17% **(3)** Western Meadowlark 8%

Overall, 45% of the fatalities were raptors. Five American Crows (0.4%) and 12 Common Ravens (1%) were also killed. The most commonly killed birds were in two size classes of body lengths: 25–30 cm and about 58 cm<sup>s94</sup>. It would be worthwhile knowing how many American Crows

**tarsus**

Right foot of Tarsus was 6.3 cm long and without toes. Was this a birth defect or early injury in the nest? This injury eventually proved to be fatal. She died 10 days after she fledged in early June. Her 3 nest mates were normal

The American Crow **254** tom4crows.com

### Population Characteristics

are killed by wind-turbines throughout the north- ern **Great Plains** where crows migrate each year.

### Television towers

These towers passively slaughter hundreds of thousands of birds. In Champaign County **Il- linois**, two researchers collected dead birds around the base of a 983 foot (300 m) tall tower. Mass mortality occurred on nights with 80–100% cloud cover and a ceiling of 400–1600 feet (122– 488 m) with fog or haze that reduced a bird's vision. Collisions with the tower or its guy wires killed, injured or stunned birds. From comparisons of seven dates, mortality was 10 times greater in the fall than in the spring. A total of 486 birds of 51 species were collected. Seventeen species of wood warblers (Parulidae) made up 70% of all dead birds. It was estimated only 85% of all birds killed at a tower were recovered. Many were never found, and some were lost to scavengers (mammals and birds). The top five kills were –

**(1)** Myrtle Warblers **(2)** Ovenbirds **(3)** Palm Warblers **(4)** Tennessee Warblers **(5)** Red-eyed Vireos

Dead birds collected in the autumn were mostly adult females <sup>70b</sup>.

At a TV tower near Ste. Agathe **Manitoba**, in late August 1979, 220 birds of 21 species were killed by collisions. All were passerines, except for one immature Sora, *Porzana carolina*. One hun- dred and eighty-six individuals were aged. Two species with the highest mortality were Swain- son's Thrush, *Catharus ustulatus*, and Red-eyed Vireo, *Vireo olivaceus* – 76% of the Swainson's Thrushes were immatures, and 92% of the Red- eyed Vireos were adults <sup>38h</sup>.

From 1969–'71 a large collection of dead birds was made in the autumn from around a TV tower erected in Orange County, **Florida**. The

tower reached 452 m into the sky. The tower and its 18 guy wires were struck by night migrants. During the three consecutive autumns –

- (1)** 2,758 birds of 55 species
- (2)** 2,793 birds of 53 species
- (3)** 2,231 birds of 67 species

were gathered for a total of 7,782 birds of 82 spe- cies. Yellowthroats, Black-throated Blue Warblers, Ovenbirds, American Redstarts, and Palm War- blers made up 69% of the hidden slaughter. The collected birds were weighed, aged, sexed and had their molt patterns recorded <sup>t24</sup>. Since Amer- ican Crows like to feed on freshly killed songbirds, they may have learned to visit the ground below TV antennas and other tall obstacles for a fresh meal of meat in the morning.

Dr. Kemper had been watching for bird fatali- ties at the 500-foot television tower at the junction of the Eau 'Clair and Chippewa Rivers in **Wiscon- sin**, but found none over 4 years. After a 1,000- foot TV tower was erected, some 400–500 birds were killed on 29 August, and some 300–400 on September 3. On 20 September, perhaps 20,000 birds littered the ground, enough to keep a family of crows happily fed for years. The author was able to salvage 1,525 individuals of 40 species. He decided “the extra 500 feet is a big factor in causing these accidents,” and

suggested television towers could be illuminated from the ground to reduce nightly deaths by collisions<sup>k29</sup>.

Carolee Caffrey saw a male yearling crow die when it crashed into a window<sup>v18</sup>. This is the only published record of the death of a crow from a window encounter. What are the number of deaths resulting from bird strikes against commercial and private buildings? Working mainly in southern **Illinois** and **Canada**, two homes, in a rural setting and in a suburban habitat, were the foci. Windows were also placed in fields to record bird strikes in that habitat. These windows had various attachments – diving falcon silhouettes, wind chimes, blinking 7-watt lights around the perimeter. Several experiments in an outdoor flight cage

involved Dark-eyes Juncos.

At the two homes, about half of the birds striking the windows were killed. The total number of strikes was 108 in one year. At the windows in fields, about half of the 33 collisions were also lethal. Juncos only avoided windows that were completely covered by white cloth drapes. Strikes eliminated large and small birds, along with those that were fit and unfit, abundant and rare. Conservatively, it was estimated the annual window kill in North America ranged from 97–975 million birds from houses, commercial buildings and schools. When you add in road kills, the indirect destruction of birds by us just being here is quite remarkable. On the replacement side, the American Ornithologists' Union (AOU) estimated there were about 20 billion birds after the breeding season each year. **NOTE:** An Indigo Bunting, *Passerina cyanea*, that was banded in Canada after

The American Crow **255** Tom Reaume 2013

### Population Characteristics

striking a window, killed itself a year later when it struck the same window<sup>k74</sup>. The next time you look out your window at a crow, remember clear glass kills more pretty songbirds than a crow.

### Window strikes

23 marked breeding **ADULT FEMALES**

**mean annual survivorship** on a golf course was 94%. Of these, 5 c  
the breeding

### Rates of dying and surviving

The yearly rates of dying for 71 banded, 18–20  
day-old nestling crows in **Illinois** were <sup>20b</sup> –

First year 58% died  
Second year 13%  
Third year 6% Fourth  
year 5% Fifth year  
10% Sixth year 4%  
Seventh year 1.5%  
Eighth year 3% died

In Encino **California**, the survival rates for  
crows were <sup>c09 c13</sup> –

97 nestlings banded 68 fledged 54 (79%) of the  
fledglings alive 2 weeks later 48 (71%) alive 2  
months later 37 (63%) survived one year 9  
crows not accounted for

Nestlings of American Crows with more weight  
and longer tarsi were more likely to survive the 2  
weeks after fledging and to one year of age than  
were the smaller nestlings <sup>c13</sup>. Over a

A Swainson's Thrush stunned from a window strike  
7-year period <sup>c11</sup> –

**URBAN** 52% (fewer predators?)

**RURAL** 35%

After the first year, the annual survivorship was  
over 70% in the city and country.

### Parasites

#### THE EXCLUSIVE CROW

The parents of a crow

Of the female  
gender To a ladies  
school

Decided to send her.

And she learned at the school

How to turn up her  
nose, In a way that was  
cruel,

At the common-school crows.

And she grew to think

She was very swell And  
that private-school crows

Had a sweeter smell.

But on that day

When the school did close

She had just as many fleas  
As the common crows.

– Wilson MacDonald 1930<sup>m06</sup>

27 marked breeding **ADULT MALES**

**mean annual survivorship** was 95%; 4 died, one disappeared; one of the five during the breeding season

Around Ithaca **New York**, post-fledging survival of American Crows for the first year<sup>m85</sup> –

## Population Characteristics

Tarsus was a pleasant crow to hold and help. She tried her best but died 10 days after she fledged in **Winnipeg**

T

erres describes birds as not one species but many, due to the variety of parasites on and in the bird's body<sup>t27</sup>.

A bird "is a living zoo."

Some names of species and information below may be outdated. A study of the (ecto-) external and (endo-) internal parasites of the American Crow, or any bird, poses a handful of problems. Ectoparasites are concealed by the thousand and one feathers covering a bird's skin. When crows for research are shot in the field, they are often thrown together in a bag by hunters. As the bodies cool the ectoparasites may abandon one crow's body and enter the feathers of another crow, thereby changing the level of intensity (number) of parasite on each bird.

After a careful autopsy, endoparasites are best viewed through a microscope to identify and measure adults, eggs and larvae. The unit of measurement is often a micron ( $\mu$ ) = 0.001 mm (one thousandth of a millimeter). To complicate matters, these parasites are hidden in organs, arterial walls, blood cells, mucous, under linings and inside muscle tissue, etc. Special staining techniques are sometimes needed to highlight their

The American Crow **257** Tom Reaume 2013

### Population Characteristics

exclusive existence. It is no wonder a thorough investigation of 100 or more crows in any locality generally results in at least one new parasitic species for that region, or for the crow.

From any large sample of birds, two levels of parasitic abundance may be given to clarify the picture and beg for regional comparisons.

**PREVALENCE (P)** percentage of crows infected in a 100 crow sample, ie. 60% of the crows were infected with one species of flea **INTENSITY (In)** number of fleas on each of the 60 infected crows – average of 33 fleas within a range of 10–50

With the crow's menu listing hundreds of items, and the life cycle of some parasites complicated by the use of one or more intermediate hosts (snails, insects, earthworms, fish, mammals, etc), the mapping of the host-parasitic relationship is a tricky job. Interactions between crows, other animals, habitat and weather further muddies the picture.

The richness of 20th century research has placed more than 100 species on the list of parasites of the crow. This number is not unusually high. Even the prettiest songbird harbors dozens of parasites.

### Parasites in nests

Before describing parasites on and in the body of the American Crow, a look at the fauna of several nests of Black-billed Magpies and one American

A pair of breeders feed on icy tidbits of a partially open pond in MarchThe American Crow **258** tom4crows.com

### Population Characteristics

Crow in western **Montana** is worth the punishment. A crow's nest with one nestling was collected on 28 May 1931. There were 47 larvae and a few puparia of *Protocalliphora avium*, a blood sucking dipterous blow-fly larvae, in the lining of fibrous material in the nest. No larvae were on the one nestling, although larvae will take blood, then fall into the nest's cup. Blood-gorged biting midges, *Culicoides biguttatus*, were also found in the nest. They feed on nestlings. An adult coleopterian beetle, *Dermestes signatus*, and feather lice, *Docophorus communis* and *Myrsidea subaequalis*, were present<sup>j20</sup>.

**Protocalliphora (a blowfly)** Birds are a host of the genus *Protocalliphora*. There are 26 species in this genus in North America. They feed on nestlings of over 30 species, including – Chipping Sparrow, American Robin,



Scarlet Tanager, House Wren, etc, along with the American Crow. Near Bozeman **Montana**, a nestling magpie had several larvae of the fly *Protocalliphora avium* in its right nostril. The larvae did not appear to bother the magpie<sup>p72</sup>. Two other studies found several parasites living in nests of crows –

(1) The larvae and pupae of *Protocalliphora*, are obligate parasites of birds. Larvae suck blood from nestlings  
(2) Dermestid beetle *Dermestes signatus* (3) Carabid beetle *Trox affinis* (4) Ants *Crematogaster* species (5)

Feather lice *Docophorus* [= *Philopterus*] *communis*, and *Myrsidea subaequalis* [= *M. cornicus*]<sup>j20, g34</sup>.

In Ithaca **New York**, the larval period of *Protocalliphora* was 10–13 days, occurring in 3 stages. Larvae were 2–15 mm long. Seventeen nests of crows were checked and 7 (41%) had from 20–343 larvae and pupae. The nest with 343 larvae held three nestlings, which appeared weaker and smaller than normal. Species of *Protocalliphora* were sought in 4,781 nests of 110 bird species. The nests were from several **Ontario** locations (east) and the intermountain region of northern **Utah** (west). In all, 34% of the nests were hosts to 20 species of *Protocalliphora*. The

nests of all the avian species, often collected after the nestlings had left, were examined in a laboratory. In the east, 24% of 2,806 nests were infested compared to 52% of western nests. Nine species of *Protocalliphora* were found in the east and 17 species in the west. In the east 17 of 20 (85%) nests of American Crows were infested. In the west 2 of 2 (100%) crows' nests were infected. A larva needs a bloodmeal from a nestling three times as it passes through its 3 instars. After a bloodmeal the larva returns to the nest. After a pre-pupal state, the pupal stage lasts 1–2 weeks, then the adult fly emerges to repeat the cycle. The large nests of solitary nesting crows and

*Tinea carnariella*, © Jim Vargo 2012, with permission

hawks make them attractive to the blow-fly. *P. avium* was the main parasite. This was partly because it has a developmental period of 13–16 days, which was a suitable fit with American Crows that have a nestling period of 30–35 days. Infestations by *Protocalliphora* depend on both the host bird and the ecological factors concerning the type and location of its nest. Other *Protocalliphora* species at (birdblowfly.com/infested.html) reported for the American Crow were *P. asiovora*, *P. deceptor*, and *P. sialia*<sup>b87</sup>.

Two species of Collembola (Spring-tails) frequented nests of crows, Wood Thrushes, catbirds, robins, Song Sparrows and Red-eyed Vireos. They were *Entomobrya assuata* and *Isotoma arborea*. Moths were common in nests of American Robins, American Crows, House Sparrows, American Redstarts and Chipping Sparrows. Larvae of the moth, *Tinea carnariella*, (**this page**) pass the winter in pupal cases and adults emerge in May. Their eggs

are laid in new nests and the cycle begins. A small Tachinid fly, *Clau- sicella usitata*, occupies nests of crows, robins, bluebirds and Song Sparrows. The fly parasit- izes other insects, including those in avian nests. *Lacchoprosopa avium*, a sarcophagid

Adult and juvenile on a parking lot looking for scraps of food

(flesh-fly), emerges from crows' nests in March, the larvae having lived on decaying vegetable matter and animal refuse in the cups<sup>d55</sup>.

## Ectoparasites (external)

**Fleas** Benton and Shatrau noted that Holland recorded many specimens of *Ceratophyllus rossitensis swansone* (fleas) from nests of crows in **Canada**. He thought the crow was the host, and not the Long-eared Owl<sup>b89, 17h</sup>. Fleas are often found in nests and on newly fledged birds. Tarsus, a fledged, malnourished crow in **Winnipeg**, was found dead one morning on the ground. She had at least 20 fleas on her small body. Even after spending a night in a freezer, as her carcass thawed in sunlight, the fleas leapt from her body.

**Lice, mites, and ticks** Most ectoparasites are blood-suckers, but some lice and mites eat only skin. Over a dozen species of external parasites may exist on one bird. Brooding of altricial nestlings, and communal roosting contribute to the spread of lice, mites and ticks<sup>52b</sup>. There are thousands of species of mites. Some life-threatening skin diseases may result from a large infestation. This is usually known as bird mange. Epidemic levels of mange have killed some passerine birds in North America. Although most mites are external, some mites are endoparasites. All wild birds carry one to several species of mites and some mites are host specific.

Their cyclical life history follows the adult, egg, larva, nymph to adult stages. Direct contact in the nest is one way of transmission. Mites can be

brushed from feathers with an old toothbrush. They are identified by various morphological features. Wild birds, such as House Sparrows, can maintain a population of mites, which may infect domestic fowl. Control in a wild population is rather futile. Birds have coexisted with mites for a very long time<sup>p37</sup>.

The physical attributes of birds, for example, the bill tip and claws of the Barn Owl, *Tyto alba*, may help control the level of ectoparasites. Barn Owls from southern **Idaho** harbored 3 species of lice. Owls with a longer hook at the tip of their bills had more lice. On the claws of their feet are comb-like serrations which remove parasites when an owl scratches its head and throat. Owls with more teeth on their claws had fewer lice. As well, owls hosted some fleas commonly found on voles and lemmings, which are part of their prey<sup>3b2</sup>. This transfer of fleas can also be expected in the American Crow, which is very fond of mice and other small mammals.

From 112 crows gathered in **Wisconsin** and **Iowa** came 5 ectoparasites –

(1) *Philopterus corvi* **Prevalence 43%** of the 46 lice collected; in breast feathers (2) *Degeeriella rotundata* **P 30%** of the 46 lice collected; in flight feathers (3) *Degeeriella secundaria* **P 20%** of the 46 lice collected; in flight feathers (4) *Myrsidea interruptata* **P 6.5%** of the 46 lice collected; in breast feathers (5) *Acarina* spp. **Prevalence 6%**; mites at the bases of breast feathers on 7 crows

Four species of biting lice, Mallophaga, (1–4 in the above list), together had an average prevalence **P** of 25%, and were collected from 26 crows in the 1930s, although when dead crows are grouped, external parasites may migrate from one crow to the next<sup>54m</sup>. A cladistic (classification) of animals according to the proportion of

measurable characteristics they have in common) study of the suborder Ischnocera of biting lice, based on their morphology, may contradict some of the names presented here<sup>04s</sup>.

In **Newfoundland**, 94 American Crows were collected, mostly by swinging a shotgun. Of these, 82 (83%) carried ectoparasites with an average of 51 parasites per infected bird within a range of 1–357<sup>a46</sup>.

Fifty crows were shot near Norman **Okla- homa**. Prevalence of mites was 40%. Mallophaga (lice), including *Menopon mesoleucum*, were found on 70% of the crows<sup>w16</sup>. In the Essig Museum of Entomology Collections, at Berkeley, California, five other online records of this louse were from crows in **Kansas** and **California**. A study was made of 198 species of external parasites from 250 bird species mostly east of the Mississippi River<sup>p42</sup>. American Crows from the

Nestling crows are first exposed to parasites from the brooding female and those inhabiting the nest Carolinas, Maryland, New York, DC, and Florida harbored –

**LICE** (1) *Degeeriella rotundata* (2) *Myrsidea americana* (3) *Philoaterus corvi*

**MITES** (1) *Liponyssus sylviarum* (2) *Trouessartia corvina*

**TICKS** (1) *Haemaphysalis leporis-palustris* (2) *Amblyomma americanum*

From a North American summary in the 1950s, there were 800 species of Mallophaga (bird lice) on about 500 species of birds<sup>m20</sup>. Three lice lived on American Crows –

(1) *Bruelia rotundata* (2) *Myrsidea interrupta* (3) *Philoaterus corvi*

S

everal species of nasal mites were found in birds from **Louisiana**. As with most studies of parasites, new species, new host records, and new geographic records were established in this study. The new one for the American Crow was *Pti- lonyssus corvi*, (page 263) which was described and identified based on the shape of its plates, and the setae of the coxae, etc. *P corvi* was the 5th species of *Ptilonys- sus* described from the host family

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### Population Characteristics

Corvidae. It was the 2nd species described from Corvidae in North America. This mite was not found on the Fish Crow or the Blue Jay in Louisi- ana<sup>p36</sup>.

In the same year, one female mite was found in the soapy wash-water of the skin from an American Crow shot (1969) at Laplace **Louisiana**. This too, was a new host record for *Knemidokop- tes jamaicensis*. About 400 by 330 microns in size, it was the first on a North American corvid p35.

parasitic worms in living animals. Three groups of helminths are –

(1) Cestodes (tapeworms) (2)  
Nematodes (roundworms) (3)  
Trematodes (flatworms)

The splendid work of Andrews and Threlfall in the 1970s compiled helminthic species and refer- ences for the genus *Corvus*. Their checklist, from

## Endoparasites (internal) mostly

**General helminthic studies** Helminths are

30%; 4 species Nematodes **P 60%**; 8 species

In the late 1930s, a survey of 112 dead crows from **Wisconsin** and **Iowa** compiled 18 species of parasites. Ninety-one (81%) of the crows were parasitized<sup>54m</sup>. Descriptions of the endoparasites and their locations –

(1) *Haemoproteus danilewskii* **P 1%**, in red blood cells; the whole cell was filled with the parasite; one crow had a heavy infestation (2) *Plasmodium relictum* **P 1%**, in red blood cells; one crow lightly infested (3) *Leucocytozoon sakharoffi* [possibly *L. berestneffi*], **P 3%**, in red blood cells of 3 crows (4) *Trypanosoma avium* was a general term for all trypanosomes in birds in the 1930s, **P 1%**, in 1 crow; the parasite contained myonemes (a contractile fibril used in movement) and the two were 46 µm and 51 µm long with short flagella and a wide undulating membrane (5) *Isospora* spp (coccidia) **P 2%**, in the shit of 2 crows (6) *Hymenolepis corvi* **P 39%**, a tapeworm in the anterior part of the small intestine of 44 crows; **In** 1–15 worms per crow; each worm 4–7.5 cm long; the commonest tapeworm in this survey (7) *Hymenolepis variable* **P 1%**, a tapeworm 2.4 cm long in the posterior part of the small intestine of 1 crow (8) *Capillaria contorta* **P 2%**, in the throat of 2 crows [crows have a throat pouch; not a crop] (9) *Acuaria anthuris* **P 17%**, a gizzard worm in 19 crows (10) *Microtetrameres helix* **P 38%**, a small nematode in the proventriculus (glandular area between the throat pouch and gizzard) of 43 crows; sexual dimorphism occurs (11) *Diplotrinaena tricusps* **P 5%**, a rare filariid

A wild crow, complete with fleas and internal parasites, pauses to drink water from the polluted Assiniboine River in **Winnipeg**; 25 August 2011  
about 1,800 articles, eased my workload<sup>a45</sup>.

Among the grand works, JW Ward in the fall of 1932, initially set the pace by checking 50 crows for external and internal parasites in **Okla- homa**<sup>w16</sup>. The prevalence (**P**) of crows harboring groups of parasites –

Mallophaga (lice) **P 70%**; 2 species  
Mites **P 40%**; 1 species Cestodes **P**

**(1) Cestodes – 2 species**

*Anomotaenia* sp small intestine  
*Variolepis variabilis* small intestine

**(2) Nematodes – 5 species** *Capillaria*

*contorta* mucosa or submucosa of the esophagus  
*Hystrichis* sp. glands of the proventriculus  
*Physalopters* sp. no location given *Acuaria anthuris*  
throat and gizzard *Diplotrriaena tricuspsis* abdominal  
air sac

**(3) Trematodes – 2 species**

*Brachylecithum americanum* liver  
*Echinostoma revolutum* small intestine

**(4) Acanthocephalans – 3 species**

*Mediorhynchus grandis* small intestine  
*Macracanthorhynchus* sp. no location given  
*Plagiorhynchus formosum* small intestine

Comparing the previous two studies in **VA** and **NC**, which are geographically separated by about 210 km (130 miles), only 3 parasites were com- mon to the birds in both studies.

Canadian research led to the appreciation of

**0.25 mm**

in the abdominal cavity of 6 crows **(12) Microfilaria P 2%**, blood stream of 2 crows; average nematode size was 130 µm by 5 µm **(13) Collyriculum faba P 6%**, 7 crows had cysts from immature flukes in the skin of the ventral surface around the anus

In **Virginia** in the 1950s, Edward Daly identified eight species of helminths (worms) in the intestines of 103 crows shot over the fall, winter and into the spring<sup>d05</sup> –

**(1) Cestodes P 54%**, 4 species **(2) Nematodes P 9%**, 2 species **(3) Trematodes P 6%**, 1 species **(4) Acanthocephalans** (thorny headed worms) **P 1%**, 1 species

The Southeastern Crow Shooters Association in **North Carolina** collected 158 birds for inspection. Shot mainly in the springtime, females made up 48% of the hunt, males 52%. Twelve species of helminths were recovered<sup>h70</sup> .

**1 dorsal 2**

ventral

**263.** A new species of nasal mite, *Ptilonyssus corvi*, was described by D Pence p36. A female

The American Crow **263** Tom Reaume 2013

### Population Characteristics

18 species of parasites living in 99 crows from **Newfoundland**<sup>a47</sup>. American Crows were collected from 12 provincial locations. There were adult females (18%), adult males (37%), immatures (40%), and adults of unknown sex (4%). Of the 99 birds, most carried helminths (**P 95%**). The average number or intensity per infected crow was **In 63** (1–190). The number of species per infected crow was 4 (1–7)<sup>a46</sup>. The parasitic load included –

**(1) Mallophaga P 83%, 3 species, In 51 (1–357) (2) Cestodes P 61%, 3 species, In 14 (1–111) (3)**

**Nematodes P 74%, 5 species, In 37 (1–153) (4) Trematodes P 80%, 3 species, In 14 (1–125) (5)**

**Acanthocephalans P 60%, 1 species (6) Haematozoan P 13%, 3 genera**

From 85 birds collected in the summer and fall of 1962 in **Manitoba**, two crows came from the Norris Lake area about 100 km north of Winnipeg. Two new helminthic records for the province were the cestode

*Hymenolepis corvi* in the small intestine, and the nematode *Microtetrameres helix* from the proventriculus<sup>08h</sup>.

Eighteen of forty crows (45%) from the Ithaca **New York** area displayed intravascular (within a blood vessel) parasites. From these 18 birds, eight (44%) had intramonocytic parasites of

*Leucocytozoon* sp., and nine (50%) had microfilaria within the pulmonary (lungs), but rarely in the hepatic (liver) blood vessels. A single crow had one large nematode within the periaortic connective tissue.

Identification was not possible. Among three cases (7.5%) of fungal pneumonia, probably *Aspergillus* sp, two

crows also showed “granulomatous pneumonia with intralesional nematode parasites.” The nematodes appeared to be *Chandlerella chitwoodae*, a fairly common parasite of the American Crow. Several birds also had *Diplotrriaena tricuspsis*, a coelomic (body cavity) filariid. *Capillaria* sp (a nematode) were present in 13 (32%) of the crows, but three birds which experienced a bacterial infection of necrotizing oral stomatitis (inflammation of the mucous membrane of the mouth) also had prolific oral capillariasis<sup>21m</sup>.

In Terry County of west **Texas**, an examination was done on 68 crows shot in October and November 1975. Most (96%) carried internal parasites. There were 3 nematode, 2 cestode, 1 trematode and 2 acanthocephalan species. Each bird was infected with an average of 2 (1–4) helminth species with no overall dominance by any species. The intensities (**In**) of infections averaged 15 (1–104) helminths per crow. No parasitic studies on the American Crow had been done in this area. Each of 5 other regions in North America held a somewhat different collection of helminthic species. Only 35% of helminthic species were found in more than one area. West Texas, Wisconsin and Iowa were the most similar in parasitic fauna, sharing 3 species. There was only one association for frequency of occurrence, that between the cestode, *Hymenolepis corvi* and the nematode, *Microtetrameres helix*. For intensity of infection, no significant paired associations developed. The above two species were located in the small intestine and proventriculus respectively. The intestine contained 4 of the 8 species. The

gizzard, proventriculus, body cavity and liver each contained one helminth<sup>n01</sup>.

in **Ohio** in the early 1960s, an internal examination was made of 339 crows – adults, immature birds and some nestlings over a 20-month period<sup>j49</sup>. Of the 31 species of parasites, 9 were new records for the crow. Generally,

The American Crow **264** tom4crows.com

### Population Characteristics

Western Canada Violet

adult crows held a larger number of parasites than immature birds. The 7 groups were –

the outer skin and feathers<sup>j49</sup> –

(1) Acarina (mites and ticks) 5 species (2) Protozoa 3 species (3) Cestoda 5 (4) Nematoda 10 (5) Trematoda 4 (6) Acanthocephala 1 (7) Insecta 3

(1) Erythrocytes 1 (2) Leucocytes 1 (3) Intestine 9 (4) Bile duct 2 (5) Gall bladder 1 (6) Cloaca and intestinal mucosa 1 (7) Mucosa of esophagus 1 (8) Trachea 1 (9) Mesentery and intestinal mucosa 1 (10) Mucosa of proventriculus 1 (11) Below horny lining of gizzard 1 (12) Body cavity 1 (13) Below meninges and in cerebral hemispheres 1 (14) Encysted in splenic mesentery 1 (15) Skin and feathers 8

The parasites used 14 internal locations plus



The three internal parasites with the highest prevalence in **Adult (Ad)** and **Immature crows (Im)** were the two nematodes<sup>j49</sup> –

*Capillaria contoria* **Ad** 64%; **Im** 58%  
*Acuaria anthuris* **Ad** 48%; **Im** 33%

and one cestode

*Hymenolepis variabilis* **Ad** 47%; **Im** 37%

Regarding parasitic intensity, 3 nematodes had a high range of intensity (**In**) in adults (**Ad**) and immature (**Im**) crows –

*Capillaria anatis* **Ad** 1–235; **Im** 1–147  
*Microtetrameres helix* **Ad** 1–172; **Im** 1–69  
*Physocephalus sexalatus* **Ad** 1–75; **Im** 1–25

## Filarioid nematodes

About 160 species of filarioids may occupy the tissues and tissue spaces in birds. A few are found on avian skin. The filarioids are treated separately

from the larger nematodes that live in the air sacs of birds and pass their thick-shelled eggs via the respiratory or digestive system. Filarioids are specialized nematode parasites that are difficult to locate in birds because of their smallness and location. They are not often pathogenic, and generally do not evoke symptoms. They are most easily detected in blood smears of birds. Microfilaria exhibit differences in sheath (present or absent), shape of tail, and length. There may be more than one species per bird. Identification is from adult filarioids, which are whitish, slender nematodes usually 1–5 cm long. These mate in the bird and the females produce microfilariae that enter a bird's blood. Nematode microfilariae are the first-stage, long-lived larvae. Blood sucking insects are the vectors (intermediate host) that ingest blood carrying these microfilariae, which then continue their development inside the insect. The infective third-stage larvae migrate to the head of the insect. When an insect feeds on another bird, the larvae break out onto the skin of the bird and enter the puncture wound. From there another larval stage develops and knowingly migrates within the bird to its final destination. For

Canada Goose in the duck pond at Assiniboine Park, **Winnipeg**

### Population Characteristics

example, in the Black-billed Magpie, the third- stage larvae of *Splendidofilaria picacardina* moves to behind the aortic and pulmonary valves in the heart muscle. Once in place, the larvae develop into adult nematodes<sup>b50</sup>.

The occurrence of 7 of 16 filarioid genera in the family Corvidae are listed below (+ = found)

***Pelecitus* + *Struthiofilaria* *Paronchocerca* + *Pseudlemdana* + *Striatofilaria* *Aproctella* *Cardiofilaria* + *Andersonfilaria* *Chandlerella* + *Splendidofilaria* + *Dessetfilaria* *Lemdana* *Aproctiana* *Sarconema* *Eulimdana* *Eufilaria* +**

From Essex County **Ontario** there were six species of filarioid nematodes (roundworms) in living and dead crows. One in particular, *Chandlerella chitwoodae*, “comprised 94% of all single species’

infections”<sup>b44</sup>. Next, the pulmonary arteries were

checked for filarioid nematodes in several birds species from southern **Ontario**. Concentrating on *Splendidofilaria* species, *S caperata* was identified in

6 birds including the American Crow<sup>b48</sup>. “S

*caperata* has a thick, striated cuticle which often appears wrinkled, and with inconspicuous lateral

alae.” The female is the larger sex –

**Females Males** Total Length 12.7–36.3  
10.3–17.2 mm Maximum width 150–290  
127–167 µm Nerve ring 107–270 100–155  
µm Oesophagus 590–1700 390–1020 µm  
Tail 75–170 73–139 µm

From 61 crows in **Georgia**, 62% were infected with only one species of microfilaria. Of the other 33 species of birds infected, the prevalence was 27%. From a total of 66 birds species checked, 51% were infected with microfilariae, adult worms, or both <sup>r98</sup>.

Additional work revealed 70% of 156 American Crows in Georgia were infected with filarial worms. Of the 109 infected crows, 26% were infected with microfilariae normally found in Blue Jays, and 71% of these 26% infections in crows also contained typical crow microfi-

larial parasites. Only 1% of the 169 infected jays hosted microfilariae usually found in crows <sup>r99</sup>.

An attempt was made to identify the intermediate hosts of filarial worms in jays and crows. Over 1,000 adult mosquitoes of 13 species were allowed to bite infected birds in 159 experiments. Engorged mosquitoes (all 13 species) were dissected from 12 hours up to 14 days after their bloodmeal. Microfilarial larvae from the crows lived 2–8 days in the thorax and abdomen of a few species of mosquitoes. Overall, the worms were quickly digested by the mosquitoes. The mosquitoes tested were not the intermediate hosts of the filarial worms. Nestlings of crows, which quickly became infected, were infected another way <sup>01r</sup>. An additional

examination of bird lice proved negative for nematodes, and 50 mites were negative for nematode larvae from a crow infected with filarial worms.

A cluster of 217 American Crows and Blue Jays in 1952 and 1953 were collected 275 km south of Atlanta **Georgia**. The filarial worms in the blood smears from the crows were blunt-tailed and without a sheath. They belonged to the family Dipetalonematidae. Averages of 20 groups of crows were shown exhibiting a period of about 1.5 years (**Graph 267**). Nineteen (19%) of the crows hosted microfilariae also found in the Blue Jay <sup>02r</sup>.

In the early 1900s, crows were obtained over two years at Gravenhurst **Ontario**. From 15 crows, 4 (27%) were infected with microfilaria (one species) in their bloodstream. The parent nematodes (filaria) were located in the coat of the pulmonary artery, but no identification was made. In fresh blood, the microfilaria averaged 188 microns (µm), and when dried and stained 173 microns. In comparison, a crow's red blood cell is about 10 microns long. A sheath was obvious in specimens stained with hematein (an oxidized derivative of haematoxylin). Most of the embryos had a clear spot, with no nuclei, located 0.6 µm from the head end. At this spot the body of the embryo had a diameter of 5.8 microns <sup>e28</sup>. Also, a few of the nucleated red blood cells were infected with *Haemoproteus*, a genus of protozoan parasites in the family Haemoproteidae occurring in the blood of some birds.

The periodicity of some microfilarial species

The American Crow **266** tom4crows.com

### Population Characteristics

**American Crow** It had a bit of inflammation and circulating microfilaria (a filarioid nematode) in its blood. Red blood cells are orangey when fresh, © Photomicrograph provided courtesy of Dr. T Stokol, Clinical Pathology, Cornell University, with permission

### CROW INFECTIONS

MAR A J JUL A SEP JAN FEB M APR MAY JUN JUL AUG SEP OCT  
1952 1953

d etcefnl % t necre P 5040302010 No. of birds 0  
10090 807060

**267.** In 20 groups of crows from **Georgia** over 1.5 years, the average rate of filarial infection (family

Dipetalonematidae) Increases and declines took about was 8–10 about weeks 80%<sup>02r</sup> between , 20 30 40 50 60 70 80 90 100  
110 120 130 140 150 160 170 180 190 200 210 220 two breeding seasons in the 1950s. © Journal of Parasitology

10 µm

The American Crow **267** Tom Reaume 2013

### Population Characteristics

licensors, with permission  
50 µm

**268.** Anterior end of female *S caperata*,  
a filarioid nematode from a Euro- pean  
Starling in southern Ontario b48, ©  
Canadian Science Publishing or its  
licensors, with permission

10 µm

**268a.** Cuticle of male *S caperata* (a, b and  
c) from a Red-winged Blackbird b48, ©  
Canadian Science Publishing or its

**268c.** Transverse section of a male *S caperata*  
from an American Crow in south- ern Ontario

The American Crow **268** tom4crows.com

**Population Characteristics**

**268. *Splendidofilaria*  
*caperata*, a filarioid  
nematode**

20  $\mu$ m 50  $\mu$ m

**268b.** Partial transverse section, an enlargement of the transverse section of *S caperata* below b48, © Canadian Science Publishing or its licensors, with permission

There are an estimated one million species of nematodes worldwide (wiki). In **Illinois**, the **American Crow** Microfilaria in peripheral blood, M = microfilaria, x360 <sup>s31</sup>, © Ronald E Scarvie 1970 and Washington State College

M

**American Crow** Resembling a contour map, a heavy infection of microfilaria in the blood, M = microfilaria x75 <sup>s31</sup>, © Ronald E Scarvie 1970 and Washington State College

caridid nematode, *Porrocaecum* sp. was found in young captive crows that were fed earthworms (an intermediate host). This nematode infects the intestines of birds <sup>p10</sup>.

A review of the genus *Dispharynx* was made for galliform and passeriform birds in **New York** state. *Dispharynx nasuta* (syn. *spiralis*), a proventricular worm, is one of the genera of spiruroid nematodes that includes parasites of the proventriculus and gizzard, usually with an intermediate stage in sow bugs (suborder Oniscidea; crustaceans). Among 32 infected perching birds, none of the 25 adults, but 17% of 12 juvenile American Crows were infected. Only 1 or 2 worms of either sex were counted in the infected crows. Ruffed Grouse, *Bonasa umbellus*, exhibited prevalence rates of 13–34% depending on age. One grouse held 246 worms <sup>g25</sup>.

One study by Chapin found the nematode *Syngamus gracilis* in a crow from the Zoological Gardens in **Philadelphia**. Chapin then assumed

has been established. Those larvae of nematodes found in blood provided a high count of microfilariae during the first hour of a crow's sleep period at the start of roosting. This shower of larvae (up to 59,000 / cm<sup>3</sup> of blood, was easily reversed by changing the timing of light over a 24-hour period. The filarial counts were considerably lower in the daytime when crows were active <sup>43b</sup>. It is not known how long filarial worms live. One adult crow, captured in February 1953, and housed in a lab remained heavily infected for 16 months <sup>02r</sup>.

## Nematodes (roundworms)

### Population Characteristics

**Chatham Ontario** Crows assembling in trees prior to roosting. Shortly after dark the microfilaria reach their peak in a crow's blood

most, if not all of *S trachea*, were misidentified and should actually be *S gracilis*. He based this supposition on a physiological reaction that made *S trachea* unsuccessful in establishing itself in a healthy chicken. From this he believed, if *S trachea* could not establish itself in a healthy chicken, then it should not be able to infect a crow.

Hence the parasite must be *Syngamus gracilis*<sup>c59</sup>. This seemed to be an error in reasoning<sup>c67</sup>. (see below)

The proventriculus is the glandular portion of the avian stomach where digestion begins on the food before it enters the gizzard. In the 1920s, a look at the wall of the proventriculus of the crow found<sup>33c</sup> –

(1) *Acuaria cordata* – males 10–11 mm long; females 22–40 mm long (2) *Microtetrameres helix* – males 5 mm long; females about 1.3 mm long (3) *Tetrameres imispina* – males absent; females 3 mm long

In the same study, but from crows' lungs –

(1) *Syngamus trachea* (gapeworm) – adults in the trachea and bronchi; larvae in lungs; immature worms in peritracheal tissue and air sacs; females 5–40 mm long; males 2–6 mm long. Both sexes are bright red.

Earthworms may support infective larvae for over 3 years (2) *Syngamus gracilis* in the trachea; females 8–11 mm long; males about 3 mm long. This species is now considered to be a synonym of *S trachea*, (1) above

***Splendidofilaria flexivaginalis* (Art 290)** A newly identified species, *Splendidofilaria flexivaginalis* was found in the 1960s in 33% of 339 American Crows in **Ohio**. This nematode was located in the mesentery



surrounding the posterior vena cava near the spleen<sup>j47</sup>. A digest from a more complete description –

**FEMALE** (n 15), body 25 (20–28) mm long by 0.15 mm wide; nerve ring 0.14 mm from the anterior end; tail tapering posteriorly; the oviducts and ovaries coiled

**Filariid nematode** adult Within the coelom (body cavity) of the American Crow is a tightly coiled 21m. Photograph by Andrew D Miller, © SAGE, with permission

The American Crow **270** tom4crows.com

### Population Characteristics

**MALE** (n 35), body 12 (8–14) mm long by less than 0.1 mm wide; the nerve ring 0.14 mm from the anterior end; tail recurved and bearing 4 or 5 pairs of post-cloacal papillae

Microfilaria (from vagina), body cylindrical, unsheathed, tapering posteriorly, 0.15 mm long by 0.005 mm wide; anterior end blunt and free of nuclei; posterior end round and with nuclei. This species most closely resembled *Splendidofilaria columbigallinae*. A key to the species within this genus was provided.

Immature crows held more adults of *Splen- didofilaria flexivaginalis* than did the mature crows. A higher

percentage of crows were hosts to this filarial worm over the summer than in the winter<sup>j47</sup>.

A

parasitic load is rarely fatal to a crow. Only one instance came my way from **England** where one Carrion Crow and two Rooks probably died from an overabundance of the nematode *Syngamus trachea* in the upper trachea<sup>t51</sup>.

Over 10 months, from February through November in south-and north-central **Florida**, birds were obtained from hunters, or captured alive in mist nests and traps. The nematode *Dispharynx nasuta*, which has a wide range of hosts and distribution, was present in the proventriculus of 7 of 11 species of birds. In American Crows, 5 of 36 (14%) were naturally infected with an average intensity of 11 (1–26) *D nasuta*. The worms had their heads buried in the proventriculus and their bodies coiled within the cavity. The proventriculi were often swollen, up to a 3-fold increase in the Boat-tailed Grackle, *Quiscalus major*. Inflammation was heaviest at the worm's point of attachment. One American Crow, with only one worm, exhibited extreme papillomatous proliferation of the mucosal surface, which caused some congestion of the cavity. The worm was a senescent female in the fall. The crow may have had a higher number of worms over the summer, which would explain the swelling<sup>r69</sup>.

From nematodes in the collection at the Institute of Parasitology, McGill University in **Mon-**

5<sup>m</sup> μ0 0<sup>100</sup> μm 20 μm  
m μ0 0<sup>1</sup> m μ0 38

100 μm

30 μm **9**

**271. NEMATODE** *Porrocaecum ensicaudatum*. 1. Head 2. Anterior end of adult 3. Male tail of adult 4. Anterior end of immature larva 5. Tail of immature dorsal view 8. Looking down on face of immature larva 9. Tail of 6. immature Head, lateral larva<sup>m61</sup> view, 7. Head,

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**treal**, one was tentatively identified as *Capillaria collaris* from a crow killed on Montreal Island. The nematodes were females, and males are necessary to best identify the species<sup>m62</sup>. The ascaroid nematode, *Porrocaecum ensicaudatum*, was described from an American Crow in **Canada** (**Art 271**). It was an adult

female 6 cm long with an oesophagus 3.3 mm long and eggs 80–90 by 55–60  $\mu\text{m}$ <sup>m61</sup>.

Next came a description of two different *Dip- lotriaena* females (probably 2 species) from two different crows from the same locality<sup>m63</sup> (**Art 272**).

**(Species 1)** 9 cm long; tridents 120  $\mu\text{m}$  long with the ends of the 3 prongs enlarged; the trident tips reach about half way to the nerve ring. The

1

2 3

4

5

6

The American Crow **271** Tom Reaume 2013

7

### Population Characteristics

distance from the anterior end of the worm to the inner nerve ring was 230  $\mu\text{m}$ . The vulva was 600  $\mu\text{m}$  from the head and the eggs were 56–60 by 33–38  $\mu\text{m}$  (microns).

**(Species 2)** 10.9 cm long with small tridents 90  $\mu\text{m}$  long with ends of the prongs bilobed and slightly enlarged; the vulva was 650  $\mu\text{m}$  from the head and eggs were 38–39 by 19–20  $\mu\text{m}$ <sup>m63</sup>.

***Diplotriaena tricuspsis*** A group of 44 American Crows were experimen- tally infected with the air sac nematode, *Dip- lotriaena tricuspsis* (*Dt*). In a wild population of 4,400 wintering crows collected in the late 1970s in Essex County in southwestern **On- tario**, the prevalence of *Dt* was almost 5%<sup>c43</sup>. After infection, the experimental crows were killed periodically and examined at intervals to follow the developmental stages of the parasite<sup>c44</sup>. Several organs in the crow were exam- ined. Below is a synopsis of the gross findings, but not the histological findings, some of which will be presented in microphotographic form.

**4–7 days** No lesions (damage to tissue) found **10–33 days** Fifth-stage nematodes recovered from external arteries of the lungs **45 days** Fifth-stage larvae visible through

Occlusion of parabronchus (a tiny passage like alveoli in mammals) in lung by a nematode (bar) and the inflammatory response to the parasite 45 days after infection, x 620<sup>c44</sup>, © Canadian Sci- ence Publishing or its licensors, with permission

external arteries of the lungs. Some larvae were under the pleura (membrane) of the darker, red- colored lungs **60–90 days** Most fifth-stage worms were within the posterior air sacs of the lungs. One dead nematode was in a capsule on the dorsal ab- dominal wall near the kidney. In another crow one nematode was encapsulated on a fold of the peritoneum (mesentery) **110–291 days** Most fifth-stage worms were alive in the posterior air sacs. Dead nematodes were encapsulated in several locations

Intensity of *Dt* averaged 4 (1–74) in crows of both sexes and all ages. The range of intensity was generally higher in juveniles (1–74) than in yearlings (1–31) and adults (1–19). Only 2.6% of the crows had an infection of nematodes of both sexes. Infections of only female nematodes in crows outnumbered male nematodes 3 to 1<sup>c43</sup>.

Other researchers have reported a low preva- lence in crows. In **Iowa**, the prevalence of *Dt* was 2.8% in 36 crows. Adult crows (n 112) in **Iowa** and **Wisconsin** showed a prevalence of 5.3% for *Dt* by the same two researchers<sup>53m, 54m</sup>.

The prevalence of this nematode in **Ohio** was 1.7% in 180 adult crows and 9.4% in 159 immature crows<sup>j49</sup>. From **North Carolina** there was a preva- lence of 0.6% in 157 crows<sup>h70</sup>. In **Quebec**, *Dt*

was found in one of two crows<sup>m63</sup>. Farther east

**272. NEMATODE** *Diplotriaena* sp. from an American Crow. (1) Trident (**species 1**) (2) Anterior end of body (**species 1**) (3) Trident (**species 2**) m63, © Canadian Science Publishing or its licensors, with permission

The American Crow **272** tom4crows.com

### Population Characteristics

1

trident

200  $\mu$  nerve

ring<sup>100  $\mu$</sup>

3

2

intensities in juvenile crows may be due to their higher consumption of insects when young<sup>c42</sup>.

The experimental infection rate of larvae of *Dt* may have been much higher than in crows feeding naturally on infected grasshoppers and crickets. There was also the possibility the Blue Jay, and not the American Crow, was the definitive host for this nematode.

At 4–7 days post inoculation (PI) larvae may be too large (825–1250  $\mu$ m by 40–52  $\mu$ m) for portal veins and sinusoids (a tiny irregularly shaped blood vessel in the liver) which resulted in some lesions. Eggs of this parasite were sometimes found encapsulated in the liver and parenchyma. Eventually, larvae left the liver through the vascular system to the heart. The larvae caused no lesions in the heart or the pulmonary arteries outside the lungs.

Giant cell granulomas (tissue with a rough surface) developed around living nematodes and persisted around dead worms. Even severe lesions in the lungs by *Diplotriaena tricuspidis* rarely produced clinical signs in crows.

### Cestodes (segmented tapeworms)

in Newfoundland, *Dt* was not reported from 99 crows<sup>a47</sup>. The low prevalences suggested *Dt* is a sporadic infector of crows. Since intensities do not increase with age, American Crows have resistance to additional infections. The higher

Tapeworms, which range throughout the Holarctic, are common helminthic parasites in birds. About 1,700 species of cestodes infect birds. And the intestine harbors most species, but some reside in the ceca and under the lining of the gizzard. Unlike other wormlike parasites, cestodes are segmented. The average prevalence of

**273. CESTODE** 4 images of *Paruterina reynoldsi* d04, © The Hel-

minthological Society of Washington  
Mature prolottid, ventral aspect  
Mature gravid prolottid

rostellum, side view

Large and small hook from

uterus

egg

g

0.03 mm

0.15 mm

Scolex (anterior end)

hooks on  
rostellum

infection ranges from 18–69%. Apparently healthy birds (hosts) may carry hundreds of tapeworms without showing any outward symptoms.

Adult cestodes, white and translucent, are usually from 1–10 mm long, but can reach 1 m in length. One cestode species may infect from a few to over a dozen avian species. Their life cycle occurs in stages, with 1 or 2 intermediate hosts. Larvae of tapeworms develop in the body cavity, muscles, or some internal organs. Some damage may be caused by larval movements from the gut. The presence of eggs or fragments of a cestode in a bird's shit are indicative of infection. Apparently, birds are unable to develop immunity to further infections by other species of tapeworms. Females of Common Eiders with a heavy load of cestodes have been known to stop nesting. It is, however, difficult to place the blame on any one parasite, since a combination of

infections by several types of parasites may lead to an altered behavior of the bird. There is no practical way to control infections of cestodes in wild birds m<sup>97</sup>. Four American Crows were shot near Ruckersville **Virginia** in the fall of 1956. A new species,

## Trematodes (flatworms, flukes)

These are the flat helminths. For vertebrates, including birds, the class is digenetic (the 2 methods of reproduction in succession). They are internal parasites, with 1 or 2 intermediate hosts in the wild. The list includes 536 species of flukes in 27 families of birds.

Digenetic trematodes are identified by the shape, location and number of suckers. The range of flukes depends on the range of the intermediate hosts they inhabit. Migratory birds help to distribute these and other parasites. Some species of trematodes are found in a wide variety of birds; others are more selective.

The life cycle involves the passage of eggs in the host's excretion

snail to infect  
when the s  
and restar  
intestine. A  
Europe de  
in a genus  
some imm  
of infection

**American Crow** Juvenile on 29 July (about 6 weeks since fledging) in **Winnipeg** has a small white streak at the base of the bill. Internal and external parasites are already a part of its life history

*Paruterina reynoldsi*, was found in the small intestine. (**Art 273**). A brief description of the tapeworm –

36 mm long by 0.9 mm wide, of 132 proglottids, each wider than long, except when gravid (with eggs). Scolex 350 µm in diameter; rostellum armed with a double circlet of 44–48 hooks 21–33 µm long.

**Female** reproduction – single ovary 60–70 µm, gravid uterus shaped like an inverted U; eggs in gravid uterus 38–42 µm in diameter. **Male** reproduction by 12–14 testes, spherical, 45–55 µm in diameter<sup>d04</sup>.

The trematode, *Collyriclum faba*, was found in several birds. The parasite was usually around the anus of nestlings or juveniles (cowbirds, robins), but its life cycle at the time (1940s) was unknown. It was found in the eastern and north central United States and parts of Europe. A list of birds infected by this trematode is provided. The American Crow, from **Michigan** and **Ohio**, was one of many species on the list<sup>f08</sup>.

The liver fluke *Brachylecithum americanum*

The American Crow **274** tom4crows.com

### Population Characteristics

(**Art 276 & 277**) was found in birds from **Georgia**, **Tennessee** and **Texas**. The hosts included meadowlarks, Mesquite and Bronzed Grackles, American Crows and Blue Jays. Two land snails (intermediate hosts) were infected with eggs of the fluke. They

hatch and the miracidia develop inside the snail into mother sporocysts in about 64 days. Inside the mother the 50–70 daughter sporocysts grow and soon rupture the mother sporocyst to escape at about day 68. They migrate to suitable areas in the

host snail. Masses of 150–300 are expelled through the respiratory pore of the snail and are attached to vegetation. The cercariae outside the snail enter a second intermediate host, the larvae of cyrtosomelid beetles that are then eaten by a bird, such as a crow, which is the final host. In the crow, adult flukes develop and lay eggs, which begins the cycle once again<sup>d36</sup>.

## Blood parasites

First a little information on the blood of birds. Mature red cells in birds are oval and contain an oval dark nuclei (wiki). Researchers looked at the number of red blood cells (RBC or erythrocytes) in 16 bird species collected from October to May. Small passerines such as sparrows, juncos and cardinals averaged 4.2–6.1 million erythrocytes per cubic millimeter ( $\text{mm}^3$ )<sup>n21</sup>. Ravens (*Corvus corax*) had 3.9 million<sup>74s</sup>, and the Carrion Crow (*Corvus corone*) in Europe had 2.5 million erythrocytes<sup>p77</sup>. [Humans averaged 4–6 million erythrocytes per  $\text{mm}^3$ .] There was no evidence that slightly larger birds had more red blood cells per unit than smaller birds<sup>n21</sup>. Nor was there much difference between females and males; nor any difference in the number of erythrocytes in migratory versus sedentary avian populations.

Within the red blood cell (erythrocyte) is hemoglobin. This is the iron-containing oxygen-transport protein in most vertebrates and all birds. Hemoglobin has two parts – 6% heme, and 94% globin, which are the heme-containing proteins involved in transporting oxygen. Hemoglobin is

measured as grams per 100 cc of blood (wiki). In seven small passerines, the weight ranged from 13.1 g in a White-throated Sparrow in late April, to 17.9 g in a male Northern Cardinal in early February. These levels are about equal to those in

humans<sup>n2</sup>

The first report of parasites in the blood of birds was in the late 1880s by Vassily Danilevsky from Russia. Then in 1897, two studies were published on parasites in blood smears of birds from Maryland<sup>o18</sup>, and Ontario<sup>m02</sup>.

Protozoa are a diverse group of unicellular eukaryotic (DNA in a distinct nucleus) organisms. Since many are motile, this may be a means of dividing them. A brief summary<sup>s31</sup> of the players by genera in the blood of birds –

**(1) Leucocytozoon** The genus *Leucocytozoon* is a vector-borne protozoan disease of birds. Most are transmitted by black flies of the family Simuliidae. Two genera of flies are vectors. Excluding Antarctica, the genus has an almost worldwide distribution. It has been found in 113 (55%) of the 204 families of birds. Perching birds are common hosts. Some ducks are susceptible to leucocytozoonosis; some even die. As with all parasitic infections, chronic and sublethal infections may alter a bird's behavior and life<sup>f59</sup>.

Its gametocytes occupy white blood cells (WBC) and displace and flatten the nuclei. Average length 12.9  $\mu\text{m}$ ; average width 10.6  $\mu\text{m}$ . In Leucocytozoidae, the variability in external measurements of 9 parameters was used to delineate species. But after comparing 5 different combi-

An American Crow explores a city on foot

refractile droplets  
egg shell stylet

**2 6**

mother sporocyst

**5**

miracidium  
daughter sporocyst  
daughter sporocyst  
refractile granules  
neck  
cercarial embryo  
mature cercaria

mature daughter sporocyst 1 mm long

cercaria

**A** stylet

**B**

cercaria

**276. TREMATODE** The liver fluke, *Brachylecithum americanum*, from the American Crow et al d36, © Journal of Parasitology

1. Egg with mature miracidium (free swimming larva) with stylet and large refractive bodies 2. Young embryo separated from mass of mother sporocyst 51 days after infection 3. Daughter sporocyst in the migrating stage 64 days after infection 4. Mature daughter sporocyst with developing and mature cercariae 5. Lateral view of cercaria (free swimming larval stage) with the ventral coiling of the tail 6. Ventral view of cercaria showing morphological details 7. Lateral view of anterior end of cercaria with position of stylet and opening of gland ducts 8. Stylet of cercaria. **A** – lateral **B** – dorso-ventral

**1**

**7**

**4**

The American Crow **276** tom4crows.com



## Population Characteristics

3

8

nations of measurements, it was concluded that “the morphometric characteristics were not valid criteria for species differentiation.” Several species are now compressed into a few species with one or more synonyms b84 .

9

10

### adult worm

**277. TREMATODE** The liver fluke, *Brachylecithum americanum*, from the American Crow et al d36, © Journal of Parasitology

9. Adult worm; ventral, unflattened 10. Adult worm, ventral with details of excretory system

## Population Characteristics



*leucocytozoon* inhabited corvids from Algonquin Park and Toronto **Ontario**. Sporozoites are found in the salivary glands of infected *Simulium* flies, which then bite and infect a bird. Birds are intermediate hosts. Some flies are restricted to certain families or genera of birds. Gametocytes, which cause marked enlargement / distortion of an infected WBC, are found in crows and ravens, along with Blue and Gray Jays.

**Experimental infection in the crow** Experimental means were tried to determine host specificity and identification. Uninfected corvids in **Ontario** were injected intrahepatically, then blood smears checked daily. Tissue was also stained and examined. The injected sporozoites, from black flies, infected hepatocytes (liver cells) and eventually developed into schizonts. These schizonts divided into merozoites after 4–6 days (**Figure 278a**). In the crow, schizonts were located in parenchymal cells of the liver 7 days post infection (PI). Spaces were noticeable in some schizonts (**Figure 278**). Mature schizonts were 15–24 by 14–20 µm. In the kidney of a crow at day 7 (PI), what appeared to be two mature schizonts were up to 63 by 25 µm. Heart, lung, pancreas, brain, bone marrow and the enlarged spleen did not harbor any schizonts. At day 35 in a crow, the above organs did not contain any sporozoites.

Parasites were in the peripheral blood 4–10 days after the birds were injected with sporozoites. They were maintained in the blood for about 5–35 days. The peak was after 9–10 days in the crow, subsiding thereafter. The results suggested leucocytozoa from the raven or crow can be transmitted to each other, but not to the Blue Jay. The species of Leucocytozoa resident in the Blue Jay did not develop in the crow or raven. Macrogametocytes (female) in crows were 11–14 by 10–13 µm, while microgametocytes (male) were 9–13 by 9–11 µm. Gametocytes were present in smears from the infected crows and ravens.

Since the gametocytes are indistinguishable, the two researchers were reluctant to give names to the *Leucocytozoon* species encountered. Additional work is needed to separate species from subspecies among infected corvids k38 .

hepatic schizont with merozoites, day 7 post infection k38, © Canadian Science Publishing or its licensors, with permission

**278. American Crow experiment.** Hepatic schizont with a thin space, day 7 post infection (PI) k38, © Canadian Science Publishing or its licensors, with permission

(wiki). It re  
tissues, bu  
birds. Ase  
There hav  
depending  
mitochond

**(3) Plasmodium** The genus *Plasmodium* is another protozoan parasite. Its distribution is global, except for Antarctica where the necessary mosquito vectors are not available. Presently, there are more than 40 species of *Plasmodium*. *Plasmodium relictum* is found in the American Crow as well as over 410 species of birds in 70 families. Its gametocytes occupy red blood cells, where it reproduces asexually, and when the parasite leaves the RBC, it migrates to various tissues. This parasite is seldom found in crows. At least three *Culex* species of mosquitoes are the vectors. Taxonomic fluctuations continue as molecular studies unravel the relationships.

**(2) Haemoproteus** About 130 species of *Haemoproteus* have been found in 72 families of birds. This protozoan is very common in perching birds. During part of its life cycle, the gametocytes parasitize red blood cells and curve around the nuclei. Average length was 12.2 µm; average width 2.6 µm. The genus *Haemoproteus* is transmitted by flies, midges, and mosquitoes

**278a. American Crow experiment.** Almost mature

**Problems with methodology** Researchers should be aware the method of collecting birds can influence the prevalence of parasites in thin blood smears. It is necessary to upgrade and redesign the methodology, if the results are to have any useful meaning<sup>f16</sup>. A suggestion was made in the 1980s

for a “tentative protocol for accurately quantifying

Hematozoa in thin blood smears.” The problem is parasitized red blood cells in birds are not evenly distributed in a smear of blood. Taking blood from live birds was preferred, and examining all the edges

Birds infected with *Plasmodium* produce a strong antibody and cell-mediated response to the parasite, but many are not able to clear the infection entirely. Male birds infected with *Plasmodium* may sing less in the spring, which could alter their selection as a mate

of a blood smear were necessary to find the clumps of parasitized erythrocytes. Extrapolating from counts of erythrocytes meant the actual count of red blood cells was always less than the

(4) *Trypanosoma avium* is a flagellated, extra-cellular parasite found in blood and bone marrow. Average length 43.6  $\mu\text{m}$ ; average width 5.6  $\mu\text{m}$ . Its vectors include mosquitoes and flies.

Another issue was the comparisons of published information on the prevalence (percent- age of birds infected in the population) of blood parasites in birds. A comparison was made on the prevalence of species in 4 genera of avian blood parasites – *Plasmodium*, *Haemoproteus*, *Leucocytozoon* and *Trypanosoma*. Biases exist between the use of microscopic tools and the PCR-based molecular method in screening samples of blood. “Differences between studies can affect detected estimates.” When using a microscope, looking at more fields produced a higher prevalence of *Plasmodium* spp than when only a few microscopic fields were examined. Biases were possible, depending on differences in the sensitivity of the method<sup>905</sup>.

Others announced that both methods of screening blood for parasites, microscopy and the PCR-based molecular, gave the same general levels of infection when results from 472 birds on 3 continents were compared. The advantages of microscopy was its relatively lower cost and the possibility of identification of different parasitic species in a blood smear<sup>903</sup>.

The final issue – a manual microscopic count of blood parasites along with the number of red blood cells needed to extrapolate the intensity of infection from 2,000 RBCs was tedious. Software is now available from the National Institute of Health to count the nuclei of red blood cells from digital images. Using digital technology, the intensity of parasites per 50,000 RBCs was above the results from manual counts, partly due to the

estimate in 10 replicates by two observers. The number of parasites per 100 erythrocytes is the standard. In **Texas**, counts of only 2,000 erythrocytes gave good figures on the intensity of *Haemoproteus maccallumi* in the blood of Mourning Doves. Technicians with the same level of training had comparable counts of the parasite<sup>928</sup>.

**American Crows** slowly gather together in late afternoon in mid-December near the roost at Chatham **Ontario**. The birds perch on the ground and in trees. Some feed, some don't. The crows keep shifting to the next assembly area as the light and wind decrease, shadows lengthen, and roosting approaches

The American Crow **279** Tom Reaume 2013

**Population Characteristics**

uneven dispersal of RBCs on a slide. The digital system seems better suited to reveal the intensity (% of RBCs infected) of low to moderate rates of infection by parasites in thin blood smears<sup>d29</sup>.

**Parasites in avian blood** Blood smears were taken from 46 Fish Crows and 42 American Crows in **Florida**. There were limitations in the methodology of looking for parasites through a compound microscope due to magnification, time, and site of blood collection (peripheral versus bone marrow). The American Crows were killed in October and November

**American Crow** *Haemoproteus macrogametocytes* (female) showing displacement of host cell's nucleus in the blood, x 850 P = parasite, HN = host cell's nucleus pushed aside s31, © Ronald E Scarvie 1970 and Washington State College  
Encapsulation of larvated egg (E – long yellow arrow) in subcapsular hepatic parenchyma by fibrocytes (short yellow arrows) in patent infection, x 2450 c44, © Canadian Science Publishing or its licensors, with permission

1975 in Glades County. Initially, American Crows were collected and examined for the nematode, *Dispharynx nasuta*, a stomach worm (5–10 mm long) found in the lining of the proventriculus and gizzard. In this study the overall prevalence was 45% (19 of 42 infected American Crows). Intensities were not given. The prevalences of the 8 blood parasites in the American Crow –

(1) *Haemoproteus picae* 17% (2) *Haemoproteus danilewskii* 5% (3) *Haemoproteus* sp 2% (4) *Plasmodium relictum* 0%

**American Crow** *Leucocytozoon microgametocyte* (male) displacing a host cell's nucleus in the blood, x 930 P = parasite, HN = host cell's nucleus pushed aside s31, © Ronald E Scarvie 1970 and Washington State College

**American Crow** *Leucocytozoon macrogametocytes* (female) which displaced a host cell's nucleus in a white blood cell, x 850 P = parasite, HN = host cell's nucleus pushed to the side s31, ©

### Population Characteristics

(5) *Trypanosoma avium* 7% (6)

*Trypanosoma ontarioensis* 2% (7)

*Trypanosoma* sp 2% (8) Unidentified

microfilariae 19%

Fifteen of the 42 American Crows (36%) were infected with one parasitic species and 4 (10%) with two species; in one case *T ontarioensis* and *H picae*. The most common parasites were *H*

The search was on for *Trypanosoma avium* in the blood and bone marrow of 677 birds in 139 species from **Colorado**. The results were split – 49% of 677 birds had *T avium* in the marrow and

*picae* and unidentified microfilaria. The prevalences in Fish Crows were quite different for most of the above parasites<sup>d77</sup>.

Researchers went after haemoproteids in two passeriform families, Corvidae and Sturnidae. Measurements were taken from blood smears. *Haemoproteus danilewskii* is quite pleomorphic (cells take on multiple structural forms) ranging from circumnuclear to a broad sausage in shape. The first form is the most common and the nucleus in the red blood cell is pushed slightly to the side by the parasite. In the sausage-like form, the nucleus is pressed against the edge of the erythrocyte. Also, the microgametocyte (male) has a slightly larger mean number of pigment granules (27) than does the female macrogametocyte (23), which is the reverse of other haemoproteid species. Regarding species, *Haemoproteus picae* in corvids can be, and probably has been confused with *H danilewskii*. *H picae* occurs in both jays and crows. A neohapantotype from Saskatoon **Saskatchewan** has been designated. There are 4 characteristics used to distinguish *Hae-*

*moproteus picae* from *H danilewskii*. As well *Halteridium danilewskyi*, *Haemoproteus corvi*, *Plasmodium danilewskyi* and *H danilewskii* var. *cairogensis* are synonyms of *Haemoproteus danilewskii*<sup>17b</sup>.

51% did not. When a bird was marrow positive for *T avium* (334 birds), only 29 / 334 (9%) had *T avium* in their blood smears. For the 343 birds that were marrow negative, only 4 / 343 (1%) had *T avium* in their blood smears. Of the 334 birds marrow positive for *T avium*, 215 (64%) had other hematozoa in their blood. For the 343 birds that were marrow negative for *T avium*, 34% had

**American Crow** *Trypanosoma* sp, in peripheral blood, K = karyosome (aggregation of chromatin), N = nucleus x 800 s31, © Ronald E Scarvie 1970 and Washington State College

Crows feeding in a harvested corn field on waste grain and insects near ephemeral water covered with a thin layer of ice; southern **Ontario** in early December



### Population Characteristics

presence of *T. avium* was a good indicator of other hematozoa<sup>34s</sup>.

A list was compiled of protozoa inhabiting the blood in **North American** birds. For the American Crow –

(1) *Plasmodium inconstans* (2)  
*Haemoproteus danilewskii* (3)  
*Haemoproteus* sp. (4)  
*Leucocytozoon berestneffi* (5)  
*Leucocytozoon sakharoffi* (6)  
*Trypanosoma avium* (7)  
*Plasmodium* sp. (8) *Leucocytozoon*  
species<sup>h85</sup>

other hematozoa in their blood. When searching for blood parasites, the bone marrow should be inspected as well as peripheral blood. As well, the

A catch of 2,385 birds in 61 species was made

at the Austin Ornithological Research Sta- tion on **Cape Cod** over the summer of 1936. The infection rate (prevalence) of blood parasites was about 9% or 209 birds. Four American Crows were caught and 2 were infected with a hae- moproteid of the *H columbae* type. One of the infected crows was too young to fly<sup>h83</sup>.

Near Auburn **Washington**, 63 American Crows were shot dead. Within a few hours, blood and tissue smears were taken and examined at three magnifications. All 63 crows harbored para- sites in their blood –

(1) *Leucocytozoon* 100% (2)  
*Haemoproteus* 86% (3)  
*Plasmodium* 21% (4)  
*Trypanosoma* 6.5% (5)  
*Microfilaria* 6.5%

Multiple infections were –

(1) 8 crows with 1 species (2)  
38 crows with 2 species (3)  
15 crows with 3 species (4) 2

When we make urban landscapes attractive, American Crows appear at our front door

crows with 4 species

None of the trypanosoma were in bone mar- row of the crows and the incidence was low in smears of tissue and blood. The highest number of microfilaria and *Leucocytozoon* were in the lung smears, rather than heart or peripheral blood smears. The highest incidence of *Haemoproteus* came from blood smears taken from the heart. The incidence of plasmodium was highest from heart smears and peripheral blood smears<sup>s31</sup>.

Researchers looked at published and un- published records for avian hematozoa in about 57,000 birds of 388 species in 55 families of breeding North American birds. The average prevalence in about 21,000 birds was 37%. Birds harbored one or more species of parasites –

Other Birds **CROW**

(1) *Haemoproteus* 19% 17% (2)  
*Leucocytozoon* 18% 20%

### **Population Characteristics**

**(3)** *Trypanosoma* 4% 4% **(4)** *Plasmodium* 4% 2% **(5)** Microfilariae 3% 2% **(6)** *Lankesterella* 0.6% 0.3% **(7)** *Haemogregarina*/ no data

Overall, the prevalence of hematozoa varied by region, the families and genera of birds. For 580 American Crows the prevalence was 27%. Beautiful waxwings carried the heaviest load of blood parasites – 70%<sup>964</sup>.



sing the haematocrit centrifuge technique, two species of trypanosomes were found in the blood of 53% (64 of 121) of American Crows from Essex County of southern **Ontario** in January and February of 1978 and 1979.

The crows overwintered and were collected alive. *Trypanosoma ontarioensis*, (**Art 283a**) a new species, is a small, slender parasite, not host specific and monomorphic. It has a well developed undulating membrane, which always ends as a free flagellum that is about one-half of the body's length. Total length including the free flagellum averaged 26 (22–35) microns. The free flagellum alone was 8.4 (5.7–11.6) microns long. The species was easily cultured in a diphasic blood-agar medium and became infective in 14 days. Four inoculated birds, including the crow, showed blood trypomastigotes.

**283.** The parasitic flagellate protozoan *Trypanosoma paddae*, 42  $\mu$ m total length, is transmitted to the crow's bloodstream by certain insects 25w, © Canadian Science Publishing or its licensors, with permission tigotes (a leaf-like form with an undulating membrane and often a free flagellum) at 28 and 48 days postinfection (PI).

The second species was the larger *Trypanosoma paddae* (**Art 283**) with an average length, including the flagellum of 42 (39–43) microns. Its free flagellum was 5.7 (5.4–5.8)  $\mu$  long<sup>25w</sup>.

At the **Oklahoma City Zoo**, 222 birds were examined for blood parasites. Of the indigenous birds, 21% were infected. One American Crow was infected with both *Haemoproteus corvi* and *Leucocytozoon sakharoffi*<sup>h14</sup>.

Blood was examined from 2,675 live passerines from 56 species for parasites at five locations in insular **Newfoundland**. From mid-May to mid-August over 4 years in the 1970s, 70% of the birds were infected. From 94 American Crows that were shot at a dump of human garbage, 13 (14%) were infected with 2 species and some microfilaria. Overall, the “low prevalence of hematozoa in the corvids was unexpected.” It was probably due to half the birds being shot in the spring before transmission from insects had started. *Leucocytozoon sakharoffi*, or perhaps the similar *L. majors*, was identified in the crows. The crows were non-migratory, and for the species of birds that did migrate, the prevalence of hematozoa (blood parasites) was similar in both groups, although the number of non-migrants was relatively small. Comparing adult and young birds, the rates of

The American Crow **283** Tom Reaume 2013

### Population Characteristics

**283a.** The parasitic flagellate protozoan *Trypanosoma ontarioensis*, 26  $\mu$ m total length, is transmitted to the crow's bloodstream by certain insects 25w, © Canadian Science Publishing or its licensors, with permission

the mosquitoes *Culicoides crepuscularis* and *C. stilobezzioides*, which fed on infected crows<sup>b82</sup>.

In migratory waterfowl, the prevalence of haematozoan parasites was compared against less migratory waterfowl. An increased distance traveled by some species was positively related to an increase in the prevalence of haematozoan infection<sup>f27</sup>. A similar study has not been done on sedentary American Crows along the coasts or on territories year round compared to migratory crows in the Great Plains of North America.

Of 618 birds from the **District of Columbia** and the Patuxent Refuge near Laurel **Maryland**, 30% were infected with blood parasites. For 16 American Crows, 44% were infected. The parasitic distribution in the crows –

(1) *Haemoproteus* 2 (13%) (2) *Leucocytozoon* 1 (6%) (3) *Plasmodium* – round 1 (6%); long 1 (6%) (4) microfilaria 4 (25%) (5) *Trypanosoma* 0

*Haemoproteus* are divided by the shape of the gametocyte into three groups. *Haemoproteus danilewskyi* surrounds a host cell's nucleus and fills the cell's cytoplasm (**Art 285**). *Leucocytozoons* are identified, not by their shape, but by the change in the host cell they infect. The host cell can become fusiform, spindle-shaped, or round. Avian *trypanosoma* are identified by their morphology. They should be looked for in bone marrow smears rather than peripheral blood smears. In American Crows, the microfilaria had 6 different forms, with an average length of 177 (150–207) µm and a width of 4.4 (3–5.6) microns. The anterior was blunt and the posterior blunt to tapered. No sheath was present w65.

An interesting article from the late 1890s described some early work on blood parasites. Using the redrawn **A–G** ink renditions (**Art 285**) of

infection were similar. Microfilaria were only found in adults, and haemoproteids were three times more numerous in adults compared to immature birds of all species<sup>b83</sup>.

Birds were inspected for blood parasites in Algonquin Park **Ontario**. Blood smears from over 3,000 resident and migratory birds were examined. Average prevalences of infected birds ranged from 35% in immature migrants to 63% in resident adults. Multiple infections were common. From 1,750 infected birds –

(1) 70% one species of parasite in their blood (2) 24% two species (3) 5% three species (4) 1% harbored 4 species of parasites

Of 10 immature American Crows, 80% tested positive for blood parasites. *Leucocytozoon* were found in 80% of the infected crows; *Haemoproteus* in 50% and *Trypanosoma* in 20%. The birds may have been too young to exhibit microfilaria. However, the presence of blood parasites in young birds meant the transmission by insect vectors took place in Algonquin Park. When the black flies *Simulium latipes*, *S. aureum* and *Prosimulium decemarticulatum*, which fed on infected crows and robins, were dissected, oocysts and sporozoites of *Leucocytozoon* were noted. As well sporozoites of *Haemoproteus* were located in the salivary glands of Terminal panicles of *Phragmites* in December 2011; the tallest wild grass in Canada

### **Population Characteristics**

Assiniboine River begins to thaw in mid-March in Winnipeg  
an infected red blood cell, it was found the young forms only took stain along their peripheral portions. The elongating parasite appeared to stick to one side of the cell's nucleus. The pigment (small stained dark spots in **(D)**) were irregularly spaced and a natural yellowish-brown color. Eventually, an oval to circular clear area appeared that did not stain well. Some people described this structure as "a vesicular nucleus containing nucleoli." By now the oval RBC of the crow had changed from its normal oval shape into a circular one **(E)**. There may be segmentation in the bone marrow

flagella of freed parasite  
 pigment granules unstained  
 space  
 pigment in peripheral rim  
 nucleus separated  
 nucleus of RBC parasite

## A B C D E F G

**285. American Crow** Elongate *Haemoproteus* parasite, the so-called halter-shaped form – *Halteridium danilewskyi* (after Labbé 1894) showing sequential growth (A–G) in an avian, nucleated, red blood cell (RBC). Stain was methylene blue and eosin in all but the flagellate form G at the right. *Halteridium* and *Haemoproteus* are synonyms. The modern name is *Haemoproteus danilewskyi* Kruse 1890 o18. Redrawn, © 1898 Rockefeller University Press. Originally published in the Journal of Experimental Medicine. **3**: 79–101. doi:10.1084/jem.3.1.79

of some birds. The process of flagellation (**G**) occurred quickly. Following a bulge on one side of the RBC, the cell's body disintegrated, the hemo- globin disappeared and a round organism and the nucleus from the RBC (**F**) remained near each other. Soon the round body began to vibrate as 0–4+ flagella suddenly appeared from the edge (**G**). The roundish object may divide. The flagella disappeared by floating away while still moving o18.

Near Peru **Nebraska**, 84 birds were collected in the warm season of 1937. Of the 35 species, 15 (43%) harbored blood parasites. In early June a large nestling crow was taken and kept in a laboratory for 13 days. It harbored a heavy infestation of *Haemoproteus danilewskyi* with all stages of growth observed and multiple infections of host cells common. Fully grown parasites completely filled the red blood cells and surrounded the nuclei. Three species of this genus are known.

The mature female parasites had a mean size of 17.4 by 3.2 µm. The elliptical to rod-shaped granules averaged 15 (10–26). The adult microgametocytes (male) averaged 16.2 by 3.4 µm. Granules averaged 17 (9–24) in number.

An immature American Crow

The American Crow **285** Tom Reaume 2013

### Population Characteristics

hosted *Leucocytozoon sakharoffi*. The host cells containing female parasites had a mean size of 17.2 by 14.1 µm. Cells with microgametocytes (male) averaged 14.8 by 12.5 microns. Blood from one of three immature crows had enough adult gametocytes to identify *Plasmodium relictum*. Finally, *Trypanosoma avium* was found in one American Crow c88.

***Isospora brachyrhynchi*** Researchers studied the infective stages of *Isospora brachyrhynchi*, (**Art 286**) a new protozoa first isolated in shit from a naturally infected American Crow captured near Luseland **Saskatchewan**. The genus *Isospora* is a coccidial parasite that causes intestinal diseases. Four pairs of crows were each given different infective doses of sporulated oocysts (the resistant cyst stage) and then killed (barbiturate overdose) 24–96 hours postinoculation (PI). The oocysts excysted in the intestines and released sporozoites. One hundred exogenous sporulated oocysts averaged 20 (15–25) by 19 (14–23.5) µm. Some 198 sporocysts ranged from 16 (14–20) by 10 (8.5–13) µm. Sporocysts were oval at one end and tapered to the opposite end forming a blunt point at the Stieda body. One hundred sporozoites averaged 13 (10–15) by 2.6 (2–3.3) µm. Typically, for the genus *Isospora*, there were 2 sporocysts per sporulated oocyst and 4 sporozoites per sporocyst (8 per oocyst).

Daily oocyst production was monitored. Parasites were not observed in the first 48 hours post infection (PI).

Sporulation time at 21 oC was 48–72 hours. The first moderate spike, due to

A nestling in a spruce will soon become a fledgling

the large initial dose of  $1.25 \times 10^5$  oocysts, at 7 days was followed by a much larger peak at days 12–13 PI before dropping off by day 30 (neither crow showed signs of illness). By 96 hours PI, second-generation merogony (asexual replication by multiple cell divisions) was throughout the small intestine and oocysts were

found. The prepatent period (time between infection of a crow with *Isospora* and the first instance of detection of a diagnostic stage of the parasite) was 5 days. The patent period (the length of time that a parasitic organism can be found in the body) lasted up to 3.5 months and was probably due to reinfection<sup>c45</sup>.

Oocysts of *Isospora brachyryhynchi* from a yearling American Crow were used to infect young hand-reared crows with no known infection of coccidia. Sporulated oocysts were collected and treated to release the sporozoites. The excystation of the sporozoites using different media, temperature and time periods was tested. "The most effective excystation (94%) was seen in oocysts that had been stored for 1 month and were incubated with 5% sodium taurodeoxycholate and 0.25% trypsin at 41 °C for 60 minutes. Varying degrees of excystation were observed using dif-

The American Crow **286** tom4crows.com

### Population Characteristics

10 µm

nucleus

sporozoite sporocyst

oocyst wall

polar granule

Stieda body


refractile body

**286.** Composite line drawing of sporulated oocyst of *Isospora brachyryhynchi*. c45, © Canadian Science Publishing or its licensors, with permission. Original art was not labeled

ferent bile salts at different temperatures on oocysts for up to 12 months." As the oocysts aged, there was less chance to excyst the sporozoites<sup>60s</sup>. It was suggested the death of the host's cells by the developing parasite was probably balanced by the creation of new cells, forming an equilibrium in the bird<sup>g65</sup>.

Within an *Isospora* sp., which remained unidentified, both spherical forms of oocysts measuring 0.020–0.021 mm, and subspherical ones at 0.020 (0.015–0.023) mm were found. The oocysts had one, non-polar, refractile granule, but did not have a residual body<sup>j49</sup>.

A report was generated on the protozoan toxoplasma (strain M-7741) obtained from chronically infected mice fed to wild mammals and birds. Toxoplasma oocysts were found in shit. Two American Crows did not produce a robust level of antibodies nor shed many oocysts after infection. Examination of crow shit occurred from days 4–21. Crows did not die from the infection, but toxoplasma oocysts could be isolated from their tissues up

to 15 months post infection<sup>22m</sup>. 

protozoan parasitism was common in all the crows, but intramonocytic protozoal organisms (probably *Leucocytozoon* sp) were found in 20% of 40 birds. A

Oak Hammock Marsh in summer; north of **Winnipeg**

seasonal parasite, it was transmitted by hematophagous (blood-feeding) arthropods. Protozoal cysts and free protozoal zoites were in the muscles and skin of three crows. The muscle cysts appeared to be *Sarcocystis* species. Although only a few birds were aged, the most severe dis-

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*Toxoplasma gondii* oocysts in a fecal floatation. <http://www.dpd.cdc.gov/dpdx/HTML/ImageLi->



brary/Toxoplasmosis\_il.htm (Jan 2013), © CDC- DPDx Laboratory, with permission

In this test, red blood cells adsorbed soluble antigen onto their surfaces, then clumped together when antiserum containing antibodies specific for the adsorbed antigen were introduced. Rural domestic cats (38%) were infected (n 47). From the 401 birds tested, 3.5% had antibodies against *Toxoplasma gondii*. The American Crow

Eleven Hawaiian Crow chicks raised the population to 77 in 2010, up from about 20 birds in 1994. Eggs of the 'alala (Hawaiian Crow) in captivity

was the highest at 14%. The rates of infection for all. Believed extinct in the wild, the captive breeding activities for 'alala

the animals tested varied are managed by the Hawaii Endangered Bird Conservation Program. This is a field program of the San Diego Zoo Institute for Conservation

by ecoregion<sup>f62</sup>.

Research working in collaboration with the State of Hawaii Division of Forestry and Wildlife, and the US Fish and Wildlife Service, Copyright © 2004 Zoological Society of San Diego

**The Hawaiian Crow** There were about 25 'Alala (Hawaiian Crows), *Corvus hawaiiensis*, in the world

were in younger crows<sup>21m</sup>. A search was conducted on 58 species of birds in western **Canada** for

macroscopic and

in the mid-1990s. When trying to reintroduce 27 of these rare corvids, about 18% of the free-ranging crows died from toxoplas-

microscopic cysts of the protozoan genus *Sarcocystis*. Three members of Corvidae were inspected and all of them had cysts. These were new records for these birds. For the American Crow, the prevalence of infection in 31 adults was 16%, and one juvenile was not infected. "The significant differences in prevalence between the

corvids indicate that the parasite(s) is not distributed randomly among species"<sup>d63</sup>.

Others explored the prevalence of *Toxoplasma gondii* (a species of parasitic protozoa, *Apicomplexa* that causes the disease toxoplasmosis) antibodies in wild animals from northern **California**. Birds were the intermediate host. The domestic cat is the main definitive host. In their shit cats passed resistant, long-lived oocysts, which became infective in a few days after deposition. Birds acquired the parasite when they ate infected prey, or from soil contaminated by the oocysts. When cats caught and ate infected birds, the cycle was repeated.

Serum samples taken from 37 species of wild mammals and 35 species of wild birds were tested by the indirect hemagglutination test (IHT).

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## Population Characteristics

C

### red blood cell

*Toxoplasma gondii* tachyzoites (red arrow). Tachyzoites are motile, asexually reproducing forms of the parasite released from an infected cell. They may be killed by a bird's immune system. An impression smear of liver from a Hawaiian Crow which died from the infection 42w, © Journal of Wildlife Diseases, with permission. Lesions were present in some birds. When the birds were placed in an outdoor aviary at the release site, their room service consisted of freshly frozen mice and rats, scrambled eggs, fruit, and vegetables.

One sick crow was treated with diclazuril and improved. Negative side effects to the liver or kidneys were not noticed in the treated bird. Feral cats may prey directly on crows, or infect crows indirectly through their shit. Mammals and insects infected with the parasite were eaten by crows. The elimination of feral cats on the island

seems impractical. Medical drugs administered to the infected rare crows may be the only solution<sup>42w</sup>. To gain more information on the parasites of all birds, bird banders should contact and work with local parasitologists at universities. Blood samples from birds would help the researchers e55. ■  
Canada Anemone in June, **Winnipeg**

A

n international depository was established in 1969 for avian blood parasites at Memo- rial University of Newfoundland, **Canada** with the support of the World Health Organization (WHO) b85.

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### Population Characteristics

Sumac fruit is often eaten by American Crows in southern Ontario during the winter

1. Female with straight vagina, (lv) \* 2. Female with curved vagina, lv 3. Female with vaginal curve above vulva, lv 4. Head of female, en face view 5. Caudal end of female, lv

\* lateral (side) view

3

**290.** *Splendidofilaria flexivaginalis* a nematode from the **4**

American Crow<sup>j47</sup>

1

2

106 7

5

8

9

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### Population Characteristics

6. Caudal end of male with 4 pairs of papillae, vv 7. Same as 6, lv 8. Caudal end of male with 5 pairs of papillae, lv 9. Same as 8, (vv) \*\* 10. Microfilaria

\*\* ventral (below) view

## SOME PARASITES OF THE AMERICAN CROW – an incomplete list

ECTOPARASITES PREVALENCE \* INTENSITY \*\* REFERENCE

(%) Ave (range)

## ■ SIPHONAPTERA – fleas

*Ceratophyllus rossittensis* Holland (1954) 17h *Ceratophyllus rossittensis swansoni* Benton & Shatrau (1965) b89

## ■ MALLOPHAGA – feather lice

*Brueelia rotundata* 44% 38 (1–262) Andrews & Threlfall (1975) a47

42% 0 (1–100) Jones (1968) j49

Malcomson (1960) m20

*Degeeriella rotundata* 30% Morgan & Waller (1941) 54m

Peters (1936) p42 Osborn (1896) o24 Ward (1935) w16 *Degeeriella secundaria* 20% Morgan & Waller (1941) 54m *Docophorus communis* Jellison & Philip (1933) j20 *Menopon mesoleucum* 70%

*Myrsidea albiceps* 64% 0 (1–278) Ward Jones (1935) (1968) w16 <sup>j49</sup> *Myrsidea americana* Peters

(1936) p42

Kellogg (1896) k24 *Myrsidea*

*interrupta* 68% 18 (1–202) Andrews & Threlfall (1975) a47

Malcomson (1960) m20 Osborn (1896) o24 7% Morgan & Waller (1941) 54m *Myrsidea subaequalis* Dobrosky (1925) d55

Jellison & Philip (1933) j20

*Philopterus corvi* 43% 0 (2–76) Jones (1968) j49

Peters (1936) p42 Malcomson (1960) m20 43% Morgan & Waller (1941) 54m *Philopterus ocellatus* 70% 19 (1–357) Andrews & Threlfall (1975) a47

## ■ ACARINIDA – mites & ticks

*Acarina* sp 6% Morgan & Waller (1941) 54m *Amblyomma americanum* Peters (1936) p42 *Analges corvinus* 32% 100+ Jones (1968) j49 *Gabucinia delibata* 76% 100+ Jones (1968) j49 *Haemaphysalis leporis-palustris* Peters (1936) p42 *Knemidokoptes jamaicensis* Pence (1972) p35 *Laminosioptes hymenopterus* 0.3% 8 Jones & Gaud (1962) j48 *Liponyssus bursa* Syn: *Ornithonyssus bursa* Ward (1935) w16 *Liponyssus sylviarum* Peters (1936) p42 *Ptilonyssus corvi* Pence (1972a) p36 *Syringophilus bipectinatus* 0.6% 7 Jones (1968) j49 *Trouessartia corvina* Peters (1936) p42 68% 100+ Jones (1968) j49

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### Population Characteristics

ECTOPARASITES PREVALENCE \* INTENSITY \*\* REFERENCE

(%) Ave (range)

## ■ DIPTERA – midges & blow flies

Culicoides biguttatus coquillett Jellison & Philip (1933) j20 Lynchia americana MacArthur (1948) m01 Ornithoica confuenta Johnson (1925) j27 Protocalliphora avium Jellison & Philip (1933) j20 Bennett & Whitworth (1992) b87 Protocalliphora asiovora Bennett & Whitworth (1992) b87 Protocalliphora deceptor Bennett & Whitworth (1992) b87 Protocalliphora sialia Bennett & Whitworth (1992) b87 Protocalliphora azurea Coutant (1915) 27c

## ENDOPARASITES PREVALENCE \* INTENSITY \*\* REFERENCE

(%) Ave (range)

### ■ CESTODA – tapeworms

Anomotaenia constricta 34% Daly (1959) d05 Anomotaenia constricta 30% (1–28) Jones (1968) j49 26% 4 (1–15) Naderman and Pence (1980) n01 Ransom (1909) r11 Williams (1929) w99 Anomotaenia sp 1% 1 Hendricks et al (1969) h70 Cladotaenia sp 1% Daly (1959) d05 Dilepis undula 57% 14 (1–111) Andrews & Threlfall (1975) a47 Hymenolepis corvi 39% 0 (1–15) Morgan & Waller (1941) 54m 25% (1–63) Jones (1968) j49 56% 5 (1–31) Naderman and Pence (1980) n01 Hodasi (1963) 08h Mayhew (1925) m65 Hymenolepis farciminosa 13% 4 (1–22) Andrews & Threlfall (1975) a47 Hymenolepis serpentulus 2% (1–18) Jones (1968) j49 Hymenolepis variabilis 1% 1 Morgan & Waller (1941) 54m 42% (1–37) Jones (1968) j49 Mayhew (1925) m65 Hymenolepis variabile Mayhew (1925) m65 Lateripores teres Ward (1935) w16 Orthoskrjabinia rostellata 0.3% 2 Jones (1968) j49 Paruterina reynoldsi 4% Daly (1958) d04 Paruterina sp Daly (1957) d03 Passerilepis crenata Jones (1968) j49 Passerilepis stylosa Hendricks (1971) h71 Hodasi (1963) 08h Schistocephalus solidus 4% 7 (1–21) Andrews & Threlfall (1975) a47 Schistotaenia tenuicirrus Chandler (1948) c57 Taenia cylindracea Hendricks (1971) h71 Ward (1935) w16 Variolepis variabilis 22% 2 Hendricks et al (1969) h70

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### Population Characteristics

### ■ NEMATODA – unsegmented roundworms

Acuaria anthuris 17% 41% (1–18) 34% 4 (1–30) Amidostomum sp 48% 22% 2.4 Acuaria cordata

*Capillaria anatis* 45% (1–235) *Capillaria collaris* *Capillaria*  
*contorta* 60% 7 (1–32) 2% 61% (1–40) 13% 1.4 64% *Capillaria*  
*resecta* 70% 32 (1–153) *Capillaria* sp 32% *Cardiofilaria*  
*pawlofskyi* 0.4% *Chandlerella chitwoodae* 65%

*Chandlerella quiscali* 2% *Cyathostoma lari* 37% 4 (1–15)

*Diplotriaena tricuspidis* 3% 5% 6% (1–9)  
0.6% 1 5% 4 (1–74) 5%

*Diplotriaena* sp

*Dispharynx nasuta*

12% 14% 11 (1–26) 17% *Eufilaria longicaudata* 15%  
*Hystrix* *corvi* *Hystrix* sp 8% 2 *Microfilaria* sp (larvae)  
27% 1% 62% 1% 6% 19% 2% 25% *Microtetrameres helix* 38%  
34% (1–172) 71% 13 (1–74)  
70% 27%

Morgan & Waller (1941) 54m Jones  
(1968) j49 Naderman and Pence  
(1980) n01 Jones (1968) j49  
Hendricks et al (1969) h70 Williams  
(1929) w99 Ward (1935) w16 Cram  
(1934a) 35c Mawson (1957) m63  
Ward (1935) w16 Williams (1929)  
w99 Cram (1927) 33c Jones (1968)  
j49 Mawson (1956a) m62 Andrews &  
Threlfall (1975) <sup>a47</sup> Morgan W& aller

(1941) 54m Jones (1968) j49  
Hendricks et al (1969) h70 Jones  
(1968) j49 Andrews & Threlfall (1975)  
a47 Miller et al (2010) 21m Bartlett  
(1979) b44 Bartlett (1979) b44 Miller  
et al (2010) 21m Bartlett 1979 b44

Andrews & Threlfall (1975) <sup>a47</sup>

Morgan & Waller (1940) 53m Morgan  
W& aller (1941) 54m Jones (1968)  
j49 Hendricks et al (1969) h70  
Cawthorn et al (1980a) c43  
Cawthorn et al (1980b) c44 Miller et  
al (2010) 21m Mawson (1957) m63  
Hendricks (1971) h71 Goble and  
Kutz (1945) g25 Rickard (1985) r69  
Goble & Kutz (1945) g25 Bartlett  
(1979) b44 Hendricks (1971) h71  
Hendricks et al (1969) h70 Love et al  
(1953) l75 Morgan W& aller (1941)  
54m Robinson (1954) r98 Bennett et  
al (1974) b83 Scarvie (1970) s31  
Dusek and Forrester (2002) d77  
Greiner et al (1975) g64 Wetmore  
(1941) w65 Morgan & Waller (1941)  
54m Jones (1968) j49 Naderman and  
Pence (1980) n01 Robinson (1954a)  
r99 Elliott (1903) e28 Cram (1927)  
33c

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### Population Characteristics

#### ■ NEMATODA – unsegmented roundworms (cont'd)

*Microtetrameres helix*

*Physaloptera* sp 1% 2 *Physocephalus sexalatus* 4% (1–75) *Porrocaecum ensicaudatum* 3% (1–2)  
7%

*Porrocaecum* sp 1% *Splendidofilaria* sp 3% 2.5 (2–3) *Splendidofilaria caperata* 21% *Splendidofilaria*  
*flexivaginalis* 38% (1–25) 33% (1–18) *Splendidofilaria quiscali* 14% (1–15) *Splendidofilaria wehri* 0.3%  
*Subulura papillosa* *Syngamus gracilis*

*Syngamus trachea* 0.3% 2

*Syngamus* sp *Tetrameres imispina* *Trichostrongylus pergracilis* *Trichostrongylus tenuis* *Tropisurus*  
*americanus* *Tropisurus unispinus* *Tropisurus* sp

Hodasi (1963) 08h Ward (1935) w16 Hendricks et al (1969) h70 Jones (1968) j49 Jones (1968) j49 Daly (1959)  
d05 Mawson (1956) m61 Daly (1959) d05 Naderman and Pence (1980) n01 Bartlett & Anderson (1981) b47  
Jones (1968) j49 Jones Jr (1961) j47 Jones (1968) j49 Bartlett (1979) b44 Ward (1935) w16 Goble & Kutz (1945)  
g25 Chapin (1925) c59 Canavan (1931) c33 Ward (1935) w16 Jones (1968) j49 Hendricks (1971) h71 Cram  
(1927) 33c Goble & Kutz (1945) g25 Canavan (1931) c33 Cram (1927) 33c Ward (1935) w16 Hendricks (1971)

h71 Hendricks (1971) h71 Hendricks (1971) h71 Canavan (1931) c33

■ **TREMATODA – flatworms (flukes) with suckers**

Amphimerus speciosus 0.3% 2 Jones (1968) j49

Beaverostomum brachychynchos

Stiles and Hassall (1896) 57s Hendricks (1971) h71 Gupta (1963) g84 Brachylecithum americanum 2% (5–30)  
Jones (1968) j49

77% 14 Hendricks et al (1969) h70 22% Denton (1945) d36

Fendinger (1952) f17 Brachylecithum stunkardi 2% 80 (35–125) Andrews & Threlfall (1975) a47 Collyriclum

faba 6% Morgan & Waller (1941) 54m

Farner (1944) f08 Hendricks (1971) h71 Conspicuum macrorchis 80% 11 (1–97) Andrews & Threlfall (1975) a47  
3% (1–5) Jones (1968) j49

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**ENDOPARASITES PREVALENCE \* INTENSITY \*\* REFERENCE**

(%) Ave (range)

**Population Characteristics**

■ **TREMATODA – flatworms (flukes) with suckers (cont'd)**

Conspicuum macrorchis Denton and Byrd (1951) d37 Corrigia plesiostomum Hendricks (1971) h71

Echinostoma revolutum 2% (1–14) Jones (1968) j49

4% 3 Hendricks et al (1969) h70 6% Daly (1959) d05 Echinostoma sp Loftin (1960) l58 Opisthorchis  
corvinus Hendricks (1971) h71 Prosthogonimus macrorchis 17% 2 (1–6) Andrews & Threlfall (1975)  
a47

Hendricks (1971) h71

Prosthogonimus ovatus Hendricks (1971) h71 Stephanoprora denticulata Mendheim (1943)

14m Stephanoprora polyceustus Hendricks (1971) h71

Beaver (1937) b71 Zonorchis

petiolatus 3% 1 Naderman and Pence (1980) n01

■ **ACANTHOCEPHALAN – intestinal, spiny-headed worms**

Centrorhynchus sp. 1.5% 1 Naderman and Pence (1980) n01 Macracanthorhynchus sp 1% 1 Hendricks et al (1969) h70 Mediorhynchus grandis 5% (1–45) Jones (1968) j49

1% 1 Hendricks et al (1969) h70 1% Daly (1959) d05 6% 2 (1–2)  
Naderman and Pence (1980) n01

Van Cleave (1918) v04

Mediorhynchus papillosum Nickol (1966) n25 Plagiorhynchus formosum 0.6% 1 Hendricks et al (1969) h70 Prosthorrhynchus formosum 61% 21 (1–190) Andrews & Threlfall (1975) a47

■ **HAEMOSPORIDAE – protozoan blood parasites**

Hematozoa 27% Greiner et al (1975) g64 Haemoproteus columbae 50% Herman (1938) h83

Haemoproteus corvi Halpern (1983) h14 Haemoproteus danilewskii 1% Morgan & Waller (1941) 54m

11% Jones (1968) j49 5% Dusek and Forrester (2002) d77

Coatney & West (1938) c88 Coatney & Jellison (1940) c89 Herman (1938) h83 Haemoproteus picae  
Coatney & Roudabush (1937) c87

17% Dusek and Forrester (2002) d77 Haemoproteus sp 6% Andrews

& Threlfall (1975) a47

33% Love et al (1953) l75 6% Bennett et al (1974) b83 2% Dusek and Forrester (2002) d77 86% Scarvie (1970) s31 17% Greiner et al (1975) g64 50% Bennett (1960) b82 2% Wetmore (1941) w65 Lankesterella 0.3% Greiner et al (1975) g64 Leucocytozoon berestneffi Coatney & Jellison (1940) c89 Leucocytozoon sakharoffi 3% Morgan & Waller (1941) 54m Coatney & West (1938) c88

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### Population Characteristics

#### ENDOPARASITES PREVALENCE \* INTENSITY \*\* REFERENCE

(%) Ave (range)

#### ■ HAEMOSPORIDAE – protozoan blood parasites (cont'd)

Leucocytozoon sakharoffi	6%	3%	Bennett (1960) b82 Wetmore (1941) w65 Morgan & Waller (1941) 54m Coatney W& est (1938) c88 Coatney (1936) c85 Dusek and Forrester (2002) d77 Bennett et al (1974) b83 Andrews & Threlfall (1975) a47
Leucocytozoon sp	6%	20%	Scarvie (1970) s31 Greiner et al (1975) g64 Wetmore (1941) w65 Morgan & Waller (1941) 54m Dusek and Forrester (2002) d77 Coatney W& est (1938) c88 Stabler et al (1966) 34s Dusek and Forrester (2002) d77 Woo (1982) 25w Woo (1982) 25w Dusek and Forrester (2002) d77 Scarvie (1970) s31 Greiner et al (1975) g64 Bennett (1960) b82 Wetmore (1941) w65 Franti et al (1976) f62 Miller et al (1972) 22m
Plasmodium relictum	1%	0%	
Plasmodium circumflexum	2%		
Plasmodium sp	2%	21%	
Trypanosoma avium	1%	2%	
		7%	
Trypanosoma ontarioensis	2%	53%	
Trypanosoma paddae		53%	
Trypanosoma sp	2%	6%	
		4%	
		20%	
		0%	
Toxoplasma gondii	14%		
Toxoplasma			
Bennett et al (1974) b83 Jones (1968) j49 Halpern (1983) h14 Andrews & Threlfall (1975) a47 Miller et al (2010) 21m Scarvie (1970) s31 Greiner et al (1975) g64			

#### ■ COCCIDIA – sporozoan infections

Isospora sp 2% Morgan & Waller (1941) 54m

14% Jones (1968) j49

Boughton (1938) 42b Isospora

brachyrynchi Cawthorn & Wobeser (1985) c45 Sarcocystis sp 16% Drouin & Mahrt (1979) d63

\* **PREVALENCE (P)** the % of crows in a 100 crow sample that are infected, ie. 60%

\*\* **INTENSITY (In)** the number of fleas per infected crow, ie. ave. 44, range (10–68)

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**Population Characteristics**